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SIZE	SQR		*	ENTER	MAG
CONT	SYS	STATEMENTS	UNIT	LIST	TOF
MON	TIC	IF	BAUD	PURGE	TON
	SQN	ELSE	CALL	NUMBER	DIM
FUNCTIONS	BIT	ON	DATA	RENUM	DEF
ABS	CRB	GOTO	READ	BOOT	NEW
ADR	CRF	GOSUB	RESTOR	GRAPH	END
ASC	MEM	POP	RETURN	TEXT	BIT
ATN	MWD	REM	STOP	PLOT	CRB
SIN	LEN	FOR	TIME	UNPLOT	CRF
COS	MCH	NEXT	WAIT	COLOUR	MEM
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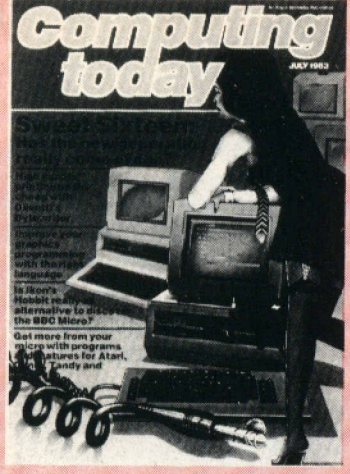

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145 Charing Cross Road, London WC2H 0EE.
Telephone 01-437 1002-7. Telex 8811896.

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Assistant Editor :
Wendy J Palmer
Advertisement Manager:
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Ron Harris BSc
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T J Connell

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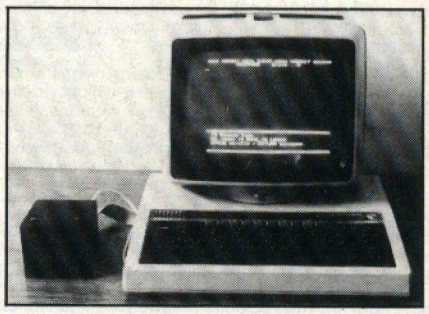
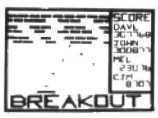
Computing Today is constantly on the look-out for well written articles and programs. If you think that your efforts meet our standards, please feel free to submit your work to us for consideration.

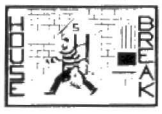
All material should be typed. Any programs submitted must be listed (cassette tapes and discs will not be accepted) and should be accompanied by sufficient documentation to enable their implementation. Please enclose an SAE if you want your manuscript returned, all submissions will be acknowledged. Any published work will be paid for.

All work for consideration should be sent to the Editor at our Charing Cross Road address.



TRS80 (LEVEL 2) ZX SPECTRUM — ZX81 SUPER SOFTWARE PACK





25 Great programmes on one pack: Star Wars, Gambling Machine, Breakout, Trap It, Population Simulation, Corridors of Doom, Housebreak, Towers of Hanoi, Butterfly Chase, The Vault, Yahtzee, Maths, Calendar, Amazing 3D Mazes, 3D Noughts & Crosses, Jackpot, Bandit, Hangman – Musical, Bible, History and Sport, Mastermind, Spelling, Diary, Records File and Time Warrior.

Here are descriptions of just a few of the games:

HOUSEBREAK You enter a house at night in an attempt to rob it of money and any gold and silver items you can find. Your object is to clean out the house. In the dark you must avoid bumping into the furniture. After an interval of time an alarm will sound and a short while later the lights will be turned on. A vicious dog is then released and you have to use all your skill and cunning to avoid getting bitten as he chases you around the house. Any injuries caused by the dog will slow down your escape. The game is played in real time, has excellent graphics and is very exciting. A new house is generated each time the game is played.

CORRIDORS OF DOOM! A dungeons & dragons type game that is very addictive. You can never win this game by chance. A lot depends on discovering the secrets of just how you have to deal with each individual monster in the game. There is a liquid which will destroy the Werewolf — but which one? How can you tame the giant spider? Will you ever learn the secret of how to defeat the Blood Devil? All of the monsters have treasures for those who are both brave and wise enough to overcome them, but to escape alive you must first cross some very nasty pits. Play it again and again.

AMAZING 3D MAZES Wander through the giant 18x18x18 mazes collecting treasures, you know where they are, but how do you get to them? Extra points are awarded for finding the shortest routes. Don't get too frustrated by apparent dead ends.

3D NOUGHTS & CROSSES Played inside a 4x4x4 cube, this is a game for the intellectual. Great graphics. It plays a mean game and wins about nine out of every ten games it plays.

TOWERS OF HANOI You will welcome this classical puzzle which is a must for anyone with a computer. The problems difficulty depends on how many disks you use. It might only take you a few minutes with four disks, but with all nine it could take all day. Two variations of the game are included. There is a constant display of Hours : Mins : Secs, so that you know how well or how badly you are doing at any particular stage. If you find you cannot work the problem out! The computer will show you the shortest possible solution.

THE VAULT A high security vault in Oxford. (The game can be changed to centre around your own home town) has ten doors, each with its own five figure combination. The combination of the nine inner doors are known, but only the manager knows the combination of the outer door. Unfortunately the manager has got himself locked in the Vault. It is your job to get him out before all the Oxygen is used up. The computer will give you metaphorical clues to how near you are getting. The time switches which change the combination every so often can prove a problem. This is a case which really puts your powers of logic to the test.

POPULATION SIMULATION This is a game for two players, each becoming the leader of one of the planets 'Techno' & 'Primo'. It is a battle to survive. Each decade a player must decide various things in governing his planet, he must carefully balance production and technology against consumption and population. He can either negotiate with his opponent or declare war on him. How about sending out an exploration party in search of new wealth. Only the experienced last very long.

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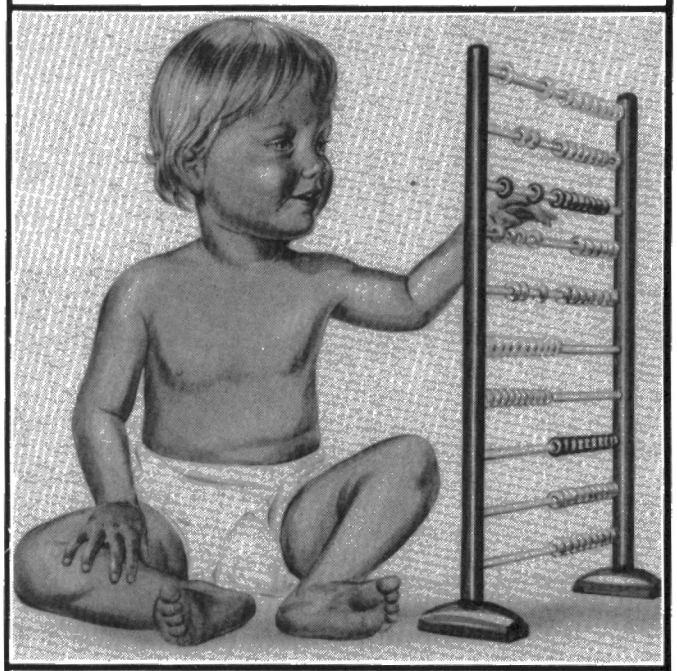

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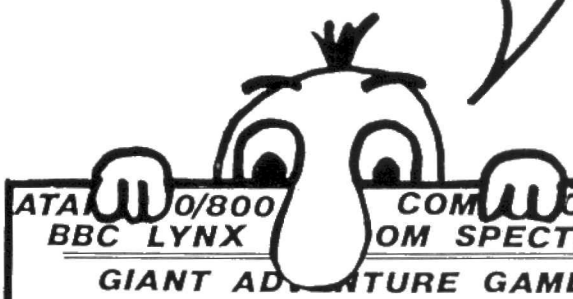

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Level 9 Computing are pleased to announce a new toolkit for "r g FORTH" on 32K BBC micros. It costs only £10 and adds the following facilities to FORTH:

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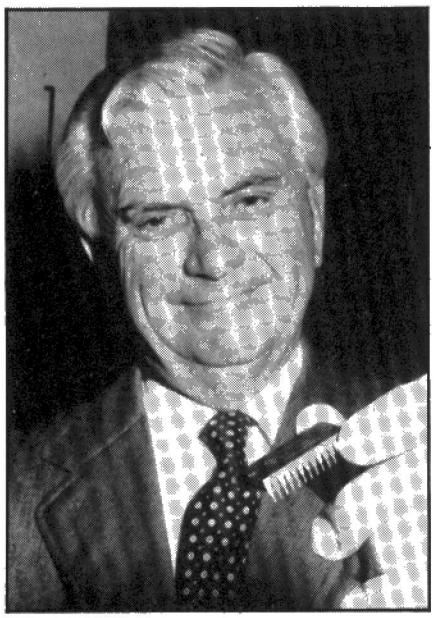
CONSUMER NEWS

HERE IS THE NEWS

Newscaster Kenneth Kendall will be the first English voice to speak on a home computer, courtesy of a new microchip containing his voice. Acorn Computer, who have developed the chip for the BBC Micro, say they believe it is the first English accent to be used in home computers and that it will be of particular help to the disabled, such as the blind and dyslectic, and a great motivation to children using computers in schools where 80% of micros (under the Department of Industry 'Micros in Primary Schools' scheme) are the Acorn made BBC model.



PLAYING WITH SORDS

Sord's M5 home computer, already a market leader in Japan, is now available in the UK. It is based on the Z-80A processor and has a 4K RAM. A domestic TV can be used as a display unit and the M5 also features audio cassette and parallel printer interfaces as well as a ROM cartridge connector, enabling games and languages such as BASIC to be run. Two joysticks are available as an optional extra.

The Sord M5 is priced at £189.95 and will be available through the normal Sord dealer network. Sord also have reached agreement with Computer Games Limited to market the M5 through thousands of retail outlets.

For more information please write to Sord, Samuel House, St Albans Street, Haymarket, London SW1Y 4SQ or 'phone 01-930 4214.

PACKING IT IN

A 32K RAMpack has been developed for the ZX Spectrum by Cheetah. An injection moulded case has been specially designed to fit the contours of the back of the ZX Spectrum perfectly, thereby eliminating the dreaded 'wobble' problem. The pack simply plugs into the user port at the rear of the ZX Spectrum and increases the 16K computer instantly to 48K. It is fully compatible with all other ZX Spectrum accessories and a special chemical applied to the gold plated edge connector ensures extra long life.

There is no need to open the computer, thereby invalidating the guarantee, no need to take an electronics degree and no need to send the computer away and wait weeks for an upgrade. The RAMpack is priced at £39.95 including VAT and postage and packing and is available by mail order (soon also at selected retail outlets) from Cheetah Marketing Limited, 359 The Strand, London WC2R 0HS. You can give them a ring at 01-240 7939 for more information.

POCKET PACKET

Joining the FX-700P/PB-100 family of pocket computers, the Casio FX-802P is the first to have an integrated printer. It makes a complete hard-copy processing system in a handy compact unit, about the size of a wallet.

At a recommended retail price of £99.95, it works out cheaper than one of the earlier 'naked' machines with an add-on printer, yet still retains full compatibility with the existing FA3 cassette interface. The language is BASIC and computing capacity includes simultaneous residence of up to 10 separate programs, totalling 1568 steps and 26 memories. Memory storage can be expanded at will in exchange for program steps, up to a maximum of 226 memories.

Printout, under direct user or program control, is on 38mm wide paper. Use of a mosaic system for both printout and LCD ensures good graphics for special symbols. Keyboard layout has been further refined, with the conventional

qwerty keys in staggered rows and with an extended space bar.

For more information you should contact Casio Electronics Co Ltd, Unit 6, 1000 North Circular Road, London NW2 7JD or 'phone 01-450 9131.

VIDEO GOINGS ON

Digithurst have announced their latest vision analysis product designed to run with the BBC Micro Model B; it allows the micro to be linked to a standard home video recorder and pre-recorded images to be transferred into the micro. The interface known as MicroEye enables pictures to be digitised with a 256 by 256 resolution, the interface being supplied as a total package providing the cable connections to both the video recorder and the BBC user port. A complete suite of software is supplied allowing the user to analyse captured images to dump them onto disc or a printer.

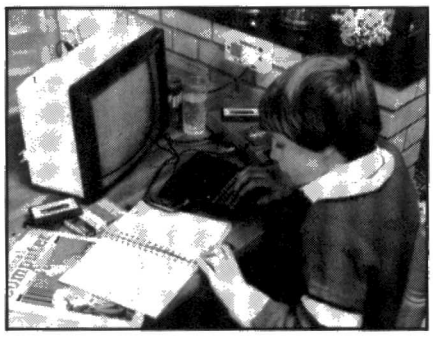
As well as running with the BBC Micro the package can also be connected to a range of other micros such as Research Machines 380Z, Apple, Hewlett-Packard, IBM, Sirius and others. The costs for the total package is £295 plus VAT and you can learn more by contacting Digithurst Limited, Leaden Hill, Orwell, Royston, Hertfordshire SG8 5QH or 'phone 0223-208926.

DICING WITH DEATH

No this isn't a new adventure game, but a much more serious subject. According to B and R Electrical Products youngsters are at risk from a variety of dangers with the increase in the numbers of micros around in the home, from

such accidents as spilling their drinks over live equipment such as the TV display or from touching live parts, frayed or broken cables, mains power supplies etc.

To overcome this problem, a domestic earth leakage circuit breaker (ELCB) designed for use around the home has been introduced. This practical device simply plugs into the mains socket. Protection against serious earth leakage shock is then provided all along the cable and at the equipment itself. The device isolates the equipment from the mains supply well within the safety limits of 30ms and 30ma thus avoiding a fatal accident. The device is called the H04 Earth Leakage Circuit Breaker and requires no wiring up, and is suitable all around the house, eg protection against electrocution from electric lawnmowers, kitchen equipment, etc.

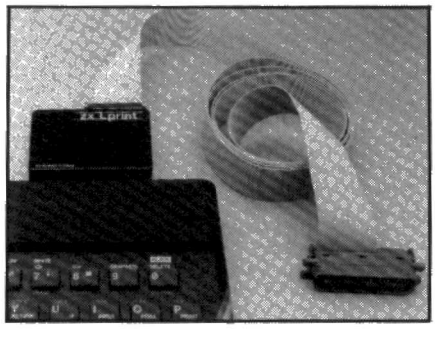


The device is priced at £29.50 including VAT, postage and packing and is available directly from B & R Electrical Products Limited, Temple Fields, Harlow, Essex CM20 2BG, or you can 'phone them at 0279-34561.

LET'S INTERFACE IT

Euroelectronics have introduced their ZX LPRINT parallel Centronics interface. It plugs directly into the ZX Spectrum rear connector and, via a ribbon cable, into almost any dot matrix or daisy wheel printer.

Any number of characters per line up to the maximum allowed by the printer in use can be printed with LPRINT command. LLIST gives the program listing complete



with Sinclair tokens. A COPY command will dump the complete screen to a high resolution graphics printer.

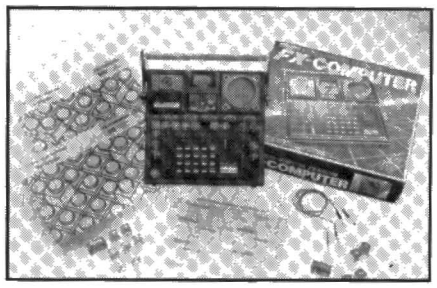
LPRINT and LLIST do not require any extra software, just the ZX LPRINT interface, but COPY software is supplied on a separate cassette.

The price for the interface, cable etc is £53.48 and is available from Euroelectronics, Zlin House, Oakfield Street, Cheltenham, Gloucestershire GL50 2UJ.

GETTING KITTED OUT

A teach yourself computer and electronics construction kit is available. The FX-Computer is claimed as an ideal introduction to the study and understanding of computers and electronics: the components are interchangeable and circuits are constructed by simply plugging specified components into the board provided in accordance with the instruction manuals. New circuits can be easily devised, built and dismantled. No soldering or wiring is involved, no tools are required: the components themselves complete the circuits. No previous knowledge is required — extensive manuals are provided.

The kit is available from most good hobby and electronics stores or from the manufacturers for £69.95 plus £3.00 for postage and packing. So if you are interested contact Electroni-kit Limited, 388 St John Street, London EC1V 4NN or 'phone 01-278 0109.



BRIEFING

For attachment to the NewBrain portable micro, Grundy Business Systems have developed a **32K EPROM module.** Designed for OEM users, scientific applications or anyone wishing to customise NewBrains, the 5" by 2" by ½" unit provides four 8K EPROM sockets and itself plugs into the micro's standard 50 pin expansion port. Priced at £55 plus VAT, the unit is available from **Grundy Business Systems Ltd.** Somerset Road, Teddington, Middlesex, or 'phone 01-943 1901.

With a view to help overcome 'techno fear' in adults not much exposed to computers, and to further develop interest among young people, **Laskys** have introduced Micropoint in all their stores. This is a special microcomputer department where customers can test and compare a wide range of the latest micros from leading manufacturers. Staff in Micropoint will be highly trained to enable them to answer questions and give expert advice.

The **RAMLOK kit** is designed to solve the problems of wobbly RAM packs on ZX80 and ZX81s. It is a gold plated male connector which replaces the computer connector and an ingenious simple mechanical clamping device which clamps the RAM pack to the computer but is simply and easily released. A version of the kit for the ZX Spectrum will soon be available. Priced at £7.50 plus 50p postage and packing you can get the kit from **Adapt Electronics,** 20 Starling Close, Buckhurst Hill, Essex IG9 5TN.

W H Smith has announced major price reductions for the Sinclair range of micros. The **ZX Spectrum** (16K) will now sell at £99.95 and the 48K ZX Spectrum is reduced to a price of £129.95. The **ZX81** has also been cut to £39.95. The store is also launching microcomputer 'shop within shops' which will offer a broader selection of computer-related goods.

Stack have added two more products to their VIC-20 range: an **IEEE-488 cartridge** which sells at £39 plus VAT and allows Commodore disc drives and printers to be used with the VIC-20; also a **Centronics interface** which allows parallel printers to be run off a VIC-20. This will sell at £29 plus VAT. Both are available from VIC-20 dealers or from **Stack Computer Services Ltd,** 290-298 Derby Road, Bootle, Liverpool L20 8LN, or 'phone them on 051-933 5511.

A new publication is available called **Careers in Computing Services.** It is aimed at young people about to leave school or college who wish to gain an understanding of the entry criteria and job/career progression within the industry. It should also be helpful to people transferring to their first job in the computing services sector. It costs £2.00 plus postage and packing if you send to **The Computing Services Industry Training Council,** 5th Floor, Hanover House, 73/74 High Holborn, London WC1V 6LE, but it should soon be available in the shops as well.

Value - MicroValue - Micro

COMPUTERS

Gemini Galaxy 2

"I would place the Galaxy at the top of my list"
(Computing Today, April 1983)

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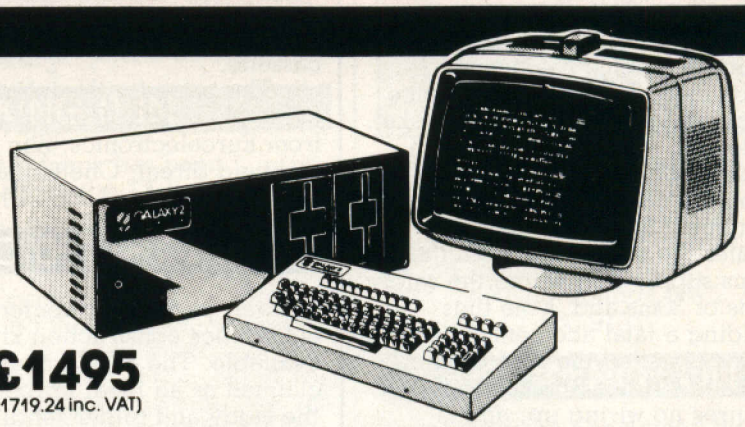
- ★64K Dynamic RAM
- ★800K Disk Capacity
- ★80x25 Video Display
- ★Serial and parallel printer interfaces
- ★Cassette and light pen interfaces
- ★User definable function keys
- ★Numeric key pad
- ★12" Monitor included



£1495
(£1719.24 inc. VAT)

Total support for Gemini & nascom Products

nascom 3 available from MicroValue

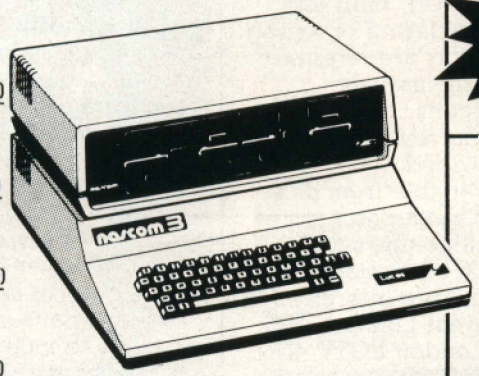
Based around the successful Nascom 2 computer, this new system can be built up into a complete disk based system. Supplied built and tested complete with PSU, Nas-Sys 3 and Nas-Gra.

48K System
£549 (£631.35 inc. VAT)

CP/M 2.2
£100 (£115 inc. VAT)

NASCOM 2 KIT
£225 (£258.75 inc. VAT)

Built & Tested
£285 (£327.75 inc. VAT)



80x25 Video for nascom

£125
(£143.75 inc. VAT)

Nascom owners can now have a professional 80x25 Video display by using the Gemini G812 Intelligent Video Card with on-board Z80A. This card does not occupy system memory space and provides over 50 user controllable functions including prog character set, fully compatible with Gemini G805 and G815/809 Disk Systems. Software supplied on Gemini system disks. Built and tested.

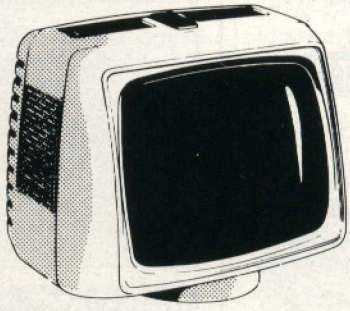
The **Microvector 256A** is a high performance graphics display interface on an 80-BUS and NASBUS compatible card. Various graphic primitives such as vector and character generation are executed in hardware by a Thompson EF9356 Graphic Display Processor. Plotting rates are typically 1 million pixels per second giving full animation capability. Various vector and character types can be selected. Characters can be scaled to give 256 different sizes.
MV 256A Suitable for TV use (PAL-UHF) **£199.00** + VAT
MV 256B Suitable for TV or RGB monitor **£220.00** + VAT

SHARP MZ80A

£475
(£546.25 inc. VAT)

Electronic magnificence from Sharp

Z80A C.P.U. · 48K RAM · 4K ROM · Industry standard Qwerty keyboard with numeric pad · 9" GREEN C.R.T. · 1200 baud cassette · Music and sound · Real time clock · Enhanced BASIC · Full editing facilities · Internal expansion.



Phoenix P12 Monitor

A high quality data display monitor, ideal for all Nascom and Gemini systems. 20MHz resolution. Available in amber or green phosphor.

£110
(£126.50 inc. VAT)

PRINTERS

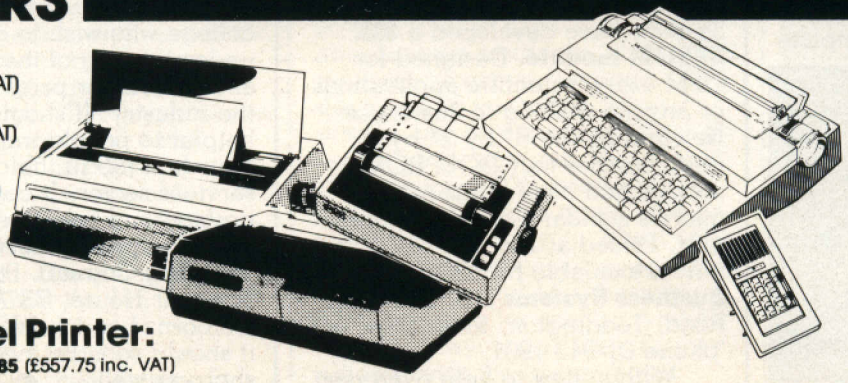
Epson FX80
£436 (£501.40 inc. VAT)

Epson RX80
£298 (£342.70 inc. VAT)

Epson MX100 Type III
£496 (£569.95 inc. VAT)

NEC 8023A
£339 (£389.95 inc. VAT)

SEIKOSHA GP100A
£215 (£246.95 inc. VAT)



Daisy Wheel Printer:

Smith-Corona TP-1 **£485** (£557.75 inc. VAT)

Olivetti Praxis 41

Complete with RS 232 interface and numeric key pad. This module enables the Praxis 41 to be used as:

- ★ a Personal Computer console
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- ★ a typewriter communicating point-to-point, or via modem, or acoustic coupler.

£595 (£684.25 inc. VAT)

Value - MicroValue - Micro

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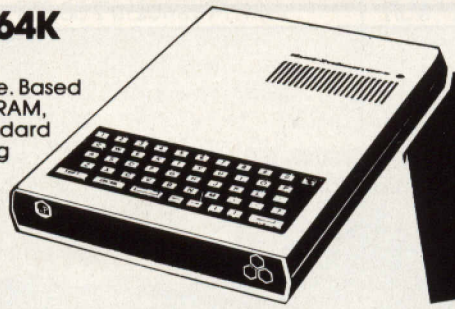
NEW

Micro Professor MPF II 64K

MPF II is a most exciting addition to our range. Based on 6502 microprocessor this machine offers 64K of RAM, high resolution 6 colour graphics, and sound. Standard BASIC interpreter is Applesoft compatible, allowing MPF II to read and write tapes in Apple format. Complete with excellent 600 page manual.



BUY FROM THE COMPUTER PROFESSIONALS

★ Micro Professor	**£233.92**	(£268.99 inc V.A.T.)
★ Joystick	**£13.00**	(£14.95 inc V.A.T.)
★ MPF II printer	**£161.53**	(£185.75 inc V.A.T.)
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Dragon 32

A powerful colour computer for under £200.

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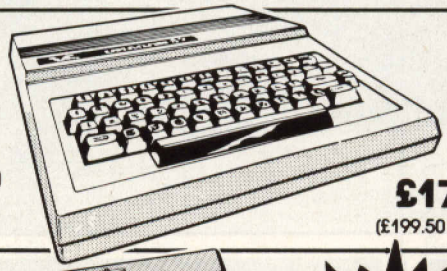
★ 6809E Microprocessor
★ Extended Microsoft Colour BASIC
★ 9 Colour, 5 Resolution Display
★ Sound through TV 5 octaves, 255 tones
★ Advanced Graphics

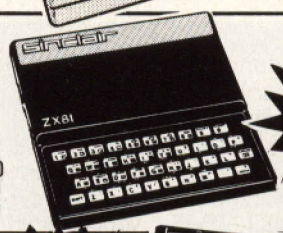
Full range of Dragon software available.



£173.47 inc. VAT
(£199.50 inc. VAT)

Sinclair ZX81

Now available through MicroValue—
a real computer for less than £50!



SPECIAL OFFER
16K RAM PACK for ZX81
£17.17 + VAT

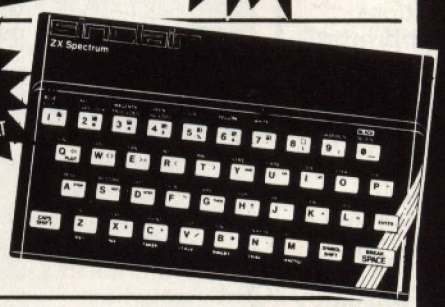
★ Sinclair ZX81 Computer	**£43.43**	(£49.95 inc. VAT)
★ Sinclair ZX Printer	**£34.74**	(£39.95 inc. VAT)
★ ZX81 Learning Lab	**£17.35**	(£19.95 inc. VAT)
★ Software for Sinclair	**from £3.43**	(£3.95 inc. VAT)

Sinclair ZX Spectrum

NEW LOW PRICES

Colour, sound and high resolution graphics from only £125

Expand your Spectrum to 48K with our new RAM PAK **£34.73** + VAT

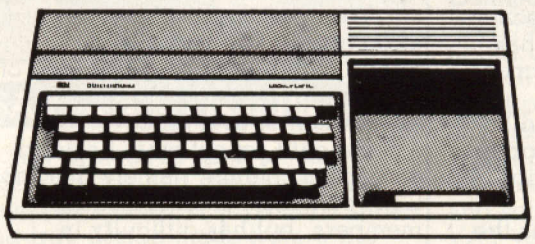


★ 16K ZX Spectrum Microcomputer **£86.92** (£99.95 incl. VAT)
★ 48K ZX Spectrum Microcomputer **£113.00** (£129.95 incl. VAT)
★ Sinclair ZX Printer **£34.74** (£39.95 inc. VAT)

Texas TI99-4A

Colour, sound and a typewriter type keyboard for under £160

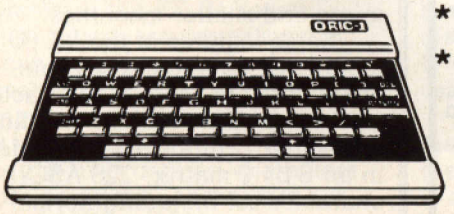
A truly expandable microcomputer system with a wide range of educational and games software.



★ Texas TI99-4A Microcomputer 16K **£139.08** (£159.95 incl. VAT)
★ Voice Synthesiser Unit **£43.43** (£49.95 incl. VAT)
★ Peripheral Expansion Unit **£130.39** (£149.95 incl. VAT)
★ Disk Drive **£278.21** (£319.95 incl. VAT) ★ Disk Control board (for above) **£165.70** (£189.95 incl. VAT)

ORIC 1

ORIC 1 when used with the ORIC MODEM will allow access to PRESTEL-Viewdata, which has 200,000 pages of interactive information covering sport, travel, hotel bookings, games, etc.



★ ORIC 1 48K Microcomputer **£147.79** (£169.95 incl. VAT)
★ ORIC 1 Communications Modem **£68.69** (£79.00 incl. VAT)

MICROVALUE DEALERS:

AMERSHAM, BUCKS
Amersham Computer Centre,
18 Woodside Road,
Tel: (02403) 22307

BRISTOL
Target Electronics Ltd.,
16 Cherry Lane.
Tel: (0272) 421196

EGHAM, SURREY
Electrovalue Ltd.,
28 St. Judes Road,
Englefield Green.
Tel: (07843) 3603

IPSWICH
MDW (Electronics),
47/49 Woodbridge Road East.
Tel: (0473) 78295

LONDON W2
Henry's Radio,
404 Edgware Road.
Tel: 01-402 6822

LONDON SW11
OFF Records,
Computer House,
58 Battersea Rise,
Clapham Junction.
Tel: 01-223 7730

MANCHESTER M19
EV Computing,
700 Burnage Lane.
Tel: 061-431 4866

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Computerama,
(Skytronics Ltd.)
357 Derby Road,
Tel: (0602) 781742

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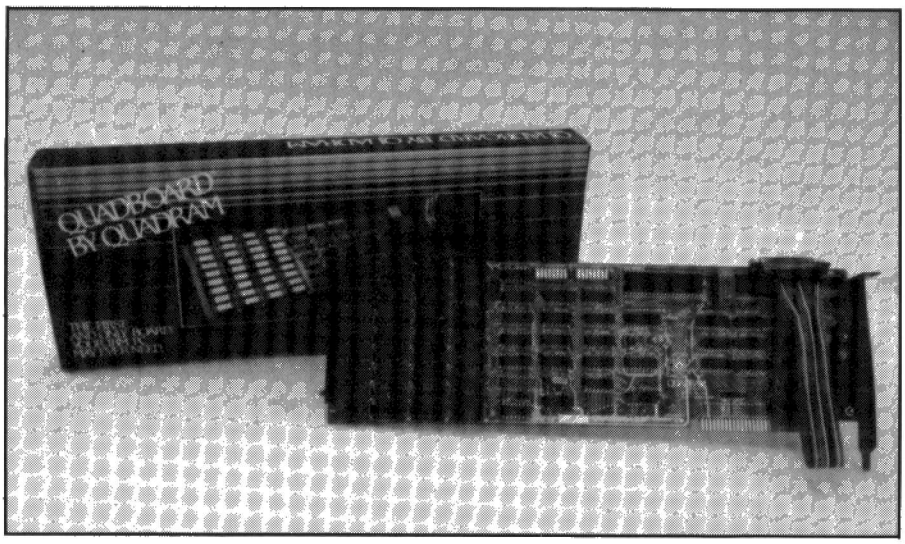
BUSINESS NEWS



IBM QUADS?

Quadboard is a multifunction card for the IBM PC now available in the UK. It is a full size six function board that can be inserted into any free system slot; it contains a serial RS232C async communications port, a Centronics parallel printer port, up to 256K of RAM, a clock/calendar, QuadRAM Drive (RAM disc), and spooler. The parallel and serial ports are functionally identical to IBM's.

The price for the different memory sized Quadboards are: £425 (64K), £535 (128K), £635 (192K), and £725 (256K). For more information please contact Pete & Pam Computers, New Hall Hey Road, Rossendale, Lancashire BB4 6JG, or 'phone 0706-227011.

CRA Corner

Recently the Computer Retailers Association held its Annual General Meeting and appointed a new Executive Committee. The current Chairman, Mr Colin Stanley, was re-elected. This is something of a landmark because in previous years the CRA has always elected a new Chairman each year. It was, however, generally thought that Colin had done such an outstanding job that we should break with tradition.

Of primary interest to ***Computing Today*** readers is the fact that in their first meeting the new Executive Committee appointed an Arbitration Officer, Mr D Bailey of Camden Computer Systems Ltd, First Floor, 462 Coventry Road, Small Heath, Birmingham, telephone no 021 773 8240. Heretofore the CRA have had a Trading Standards Officer who received complaints from the public regarding computer retailers and, of course in particular, computer retailers who are members of the CRA. In fact his duties evolved into those of arbitrator between the retailer and his customer. Hence, the appointment of an Arbitration Officer who is now totally responsible for this aspect of the CRA's activities.

We hope that this new appointment will provide the public with an improved service of arbitration, hopefully to the satisfaction of everyone.

I should repeat what I said in an earlier column, namely that the CRA can exert pressure on its members, but has difficulty in doing so with non members, although we are prepared to investigate complaints against non members. This change of course is a very good reason why you, the public, should make sure that the dealer from whom you are buying is a member of the Computer Retailers Association.

Any readers of ***Computing Today*** who feel they have a complaint against a retailer should contact Mr Bailey of Camden Computer Systems, Birmingham.

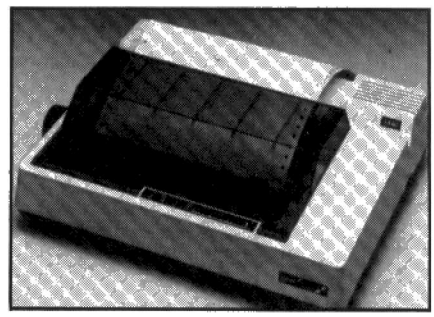
A J Harding

GIVE US A SIGN

Semaphore is a unique communication system which provides instantly available links between most currently available micro, mini and mainframe computers. The system incorporates two separate elements: Semaphore software, enabling microcomputers to be linked together or with minis or mainframes, and the Semaphore 'Blue Box', which can turn a dumb terminal into a remote-job-entry station as well as providing an alternative method for mainframe/minicomputer communication.

The software system, which requires no additional hardware, makes two-way error free file transfers over ordinary telephone lines and will operate with any of the popular CP/M, CP/M-86 and MS-DOS microcomputers and with DEC, Prime, Eclipse and IBM minis and mainframes. For each computer a tailored Semaphore software package is supplied.

The price of the Semaphore software available on floppy disc or cassette starts at £125 for the CP/M package and the Semaphore Blue Box costs from £690. Further details are available from Albetros Limited, Frances Road, Basingstoke, Hampshire.



GOING DOTTY

A new 80 column dot matrix printer, the LX 80, has been introduced by Lucas Logic and is suitable for educational, scientific and personal applications working alongside the Lucas NASCOM 3 micro and similar machines.

Some features of the LX 80 include 80 characters per line, 10 characters per inch, 80 characters per second bidirectional printing, dot matrix print using 7 by 8 dots in an 8 by 9 matrix, 228 ASCII character set including normal and italic scripts, full graphics

facilities, software selection of print, subscripts, superscripts, underlining, emphasised and double print and vertical and horizontal tab control.

The LX 80 has an introductory retail price of £319 plus VAT and is available through all established Lucas NASCOM dealers and stockists. For more information please contact Lucas Logic Limited, Welton Road, Wedgnock Industrial Estate, Warwick CV34 5QZ.

HUNGARIAN EXPORT DRIVE

The MCD-1 is a 3" single-sided floppy disc enclosed in a solid plastic cassette, similar in size to the familiar audio tape cassette. The access openings for the read/write heads and for the drive spindle are completely covered by a spring loaded shutter. The shutter is automatically retracted when the cassette is inserted into the front slot of the drive unit allowing drive spindle and head to engage the disc.

As a result of being inside the cassette the disc material itself is safeguarded against physical damage; the cassette can only be inserted in one way and accidental withdrawal of the cassette during reading or writing is prevented by an interlock mechanism controlled by head load.

The capacity (formatted) of the present version of the disc is up to 150K with a transfer rate of 250 baud. The driver unit itself has a simple but strong design and field servicing is simple.

Specifically for the VIC-20 user is the MCD-20 and comes ready to plug into your VIC-20 with drive(s) in case, power supply, interface connector, controller, operating software and instruction manual with one microdisc cassette per drive at a price of £180 for a single order.

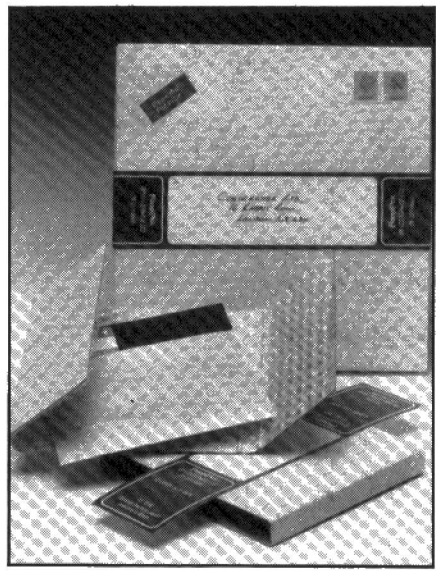
For information on the MCD-1 or MCD-20 contact BATS-NCI Ltd, Abacus House, 53-55 Ballards Lane, N London N3 1XP.

GETTING IN PRINT

Two new printers are being introduced to the UK market by Epson. With the FX 80 Versatile Printer, any character or symbol that can be defined in an 11 by 9 dot matrix can be added as part of its character set and stored in the 4352 byte bulk storage RAM which holds 256 user defined characters. Should additional characters not be required the RAM is used as a 3K input data buffer. The 12K ROM provides a number of features to increase the FX 80's usefulness and there are 136 character styles available. The FX 80 is compatible with the MX series and prints at 160 characters per second. It is priced at £438.

The RX 80 Personal Printer uses proven Epson MX series technology. Included are ROM expansion to 8K and a printing speed of 100 characters per second. The RX 80 has two full 96 ASCII character sets plus 11 international character sets, 128 types of characters. Character programming is simple and easy and 12 bytes of one byte command and an expanded command group of 54 commands are provided. At the time of writing the RX 80 had not been launched but the price is expected to be around £300.

For more details please write to Epson (UK) Limited, Dorland House, 388 High Road, Wembley, Middlesex HA9 6UH or 'phone 01-900 0466.



SAVE OUR FLOPPIES

A new protective pack for floppy disc dispatch and storage has been developed; the Floppipak is a slide and tray design made from white line board with foil and 'Aircap' bubble cushion material providing a measure of protection against magnetic fields. The Floppipak aims to help overcome the problems of data corruption frequently experienced with handling and mailing of floppy discs. Available for both 5¼" and 8" discs, the Floppipak is easy to use and can hold up to four discs.

As a result of demand from major microcomputer suppliers, the Floppisafe was developed. This is a one piece fold-over white card lined only with foil but includes the security tapes. It is designed for use within the microcomputer package where security of the floppy disc is important.

Since costs of these products will often depend on the numbers involved you should write to Costerwise Limited, 16 Rabbit Row, London W8 ('phone 01-221 0666) for details and pricing.

BRIEFING

The **Hyperion** portable business computer has been launched in the UK. It consists of a processor, screen, keyboard and up to two disc drives all of which pack together to form a compact unit weighing less than 20 lbs. Launched with the Hyperion are two application programs, Multiplan for financial modelling and IN:SCRIBE for text editing. Costing from £2,899 more details are available from **Gulfstream Computer Products Limited,** Unit 3A, Tunnel Estate, 726 London Road, West Thurrock, Grays, Essex RM16 1LS or 'phone 04026-4926.

Laskys are offering customers at Micropoint, the new microcomputer department in their stores, a portable colour TV worth nearly £200 and £100 worth of software when they purchase the **Apple Home Base System.** The system, worth £1398 includes the Apple IIe, the latest in a series of successful computers from Apple with 64K memory and excellent graphics plus disc drive and control adaptor which makes it compatible with any normal TV.

INTERPOD is an ingenious multiple interface that enables the Commodore 64 to make use of the wide range of printers and disc units currently on the market. INTERPOD plugs directly into the serial port of the Commodore 64 and has as standard both RS232 and IEEE interfaces. It also remains transparent to both the machine and software. Priced at £125 plus VAT you can get more details from **Oxford Computer Systems,** Hensington Road, Woodstock, Oxford.

Braid is to release a new multipurpose high intelligibility speech synthesizer with an onboard microprocessor. This self contained unit can be attached in place of a printer to virtually any computer and uses a text-to-speech algorithm which converts ASCII text stream to speech with a high degree of information is available from **Braid Systems Limited,** 175-179 St John Street, London EC1V 4LS or 'phone 01-253 0966.

AVAILABLE NOW

DRAGON 32 OWNERS

AVAILABLE NOW

Now you can buy a professional disk system to turn your Dragon into a real computer!

DELTA DISC SYSTEM

THE DELTA DISK SYSTEM gives you ....

* An affordable disk system
* Powerful DELTA disk commands - see right
* Random, Sequential and Indexed file-handling
* Simple plug-in to DRAGON - unlike other systems there are NO HARDWARE MODS needed to run DELTA!
* Easily expandable 100K to 1.6 megabyte storage
* Full range of business, utility and games software close to release
* The price you see is the price you pay - NO HIDDEN RAM upgrade costs
* Uses under 2K of user-RAM as DELTA is held in EPROM

DELTA contains the following powerful new words, all accessible directly from BASIC:-

SAVE"	SAVEM"	LOAD"
LOADM"	RUN"	RUNM"
CHAIN"	APPEND"	DIR
INIT	CONFIG	KILL
ASSIGN	VERIFY	SELECT
COPY	BACKUP	CREATE
FLUSH	OPEN	CLOSE
FILES	END#	RESTORE#
DIM#	BOOT	INPUT
PRINT	FIND	BUILD
DO		IF EOF(x) THEN

DELTA CARTRIDGE - contains DELTA Disk Operating System, User Manual, demonstration diskette.	£99.95
DELTA 1 - DELTA Cartridge, User Manual, a single-sided 40 track (100K) drive plus free cable	£299.95
DELTA 2 - as DELTA 1, but with a double-sided (200K) drive	£345.95
Disk Interface cable (supplied free with DELTA 1 or 2)	£9.95
ENCODER 09 assembler/disassembler/editor - integral with DELTA	£34.95
INFORM - Data Base Management System commissioned especially for DELTA systems	£39.95

SCRIBE - true lower case on DRAGON!

Below is a live 'screen dump', generated by our HIPRINT program. It clearly shows the features and display potential of SCRIBE!

SCRIBE for the DRAGON 32

* FULL UPPER and lower case direct from the keyboard
* An enlarged 42 x 24 screen display which gives a superb READABLE text
* Full text display on hi-res screen
* Automatic underline & reverse image
* Up to 255 user-defined graphics
* Precision character position command giving super/subscripts
* Black on white text display option
* A new PRINT@ command extending to 1008 thus almost doubling screen area

Cassette £13.95 DELTA disk £14.95

ENCODER 09 - is a full symbolic assembler using standard mnemonics and pseudo op-codes. Source code can be incorporated into BASIC programs. The monitor section contains commands to allow memory display, modification and execution. Memory block move, breakpoint handling, full disassembly and a full editor are only a few of its many features. The most powerful assembler/disassembler/editor available for the DRAGON 32. Available as either an integral DELTA fitment or on cassette.

Tape £29.95.Disk - see above

HIPRINT - screen dumper

- will dump the entire contents of your DRAGON 32 high-res screen to a high resolution printer. Can be used for design, display etc (see left). Available at present for EPSON printers only. Other modules to follow shortly.

Tape £13.95 DELTA disk £14.95

POSTAGE and PACKING
Software 95p. DELTA systems £4.50.
ALL PRICES INCLUDE VAT.
Send SAE for full catalogue.

PREMIER MICROSYSTEMS

208 Croydon Road, Anerley, London SE20 7YX.

Access

TELEPHONE 01-659-7131 or 778-1706

Dealer and Overseas orders welcomed

BARCLAYCARD VISA

SOFT WARES

FORCE TO BE RECKONED WITH

A variety of software packages have been released by Work Force. The first is a dice game Yahtzi, a simulation of 'That' strategic dice game normally requiring paper and dice. Up to six players are allowed and the program itself acts as umpire, auto scorepad and dice thrower. It is available at £5.50 including VAT and postage and packing and should also be available from retailers carrying the Work Force range.

Shifty is the name of a word processor for the ZX Spectrum. Basically the package takes the ZX Spectrum's printer and makes it print sideways in order to achieve the width required for good presentation. Shifty comes complete with instructions for use and a sample letter on tape for £7.50 including VAT and postage A 48K ZX Spectrum and ZX printer are required to operate the program.

For more details regarding these or other Work Force programs you should write to Work Force, 140 Wilsden Avenue, Luton, Bedfordshire or ring them on 0582-454456.

EDUCATING ARCHIE

The educational software people, Chalksoft, have released their first program for the ZX Spectrum. Invisible Man is aimed at helping children aged seven to 13 learn more about co-ordinates and compass points. A cartoon man is drawn and then hidden in a grid (10 by 15) properly labelled with axes and the child feeds in co-ordinates until the man is found. Already available for the BBC Micro and the VIC-20, the ZX Spectrum version costs £5.95. Chalksoft intend to support the ZX Spectrum by releasing educational tapes regularly.

Chalksoft have also reworked their VIC-20 tapes so that they can be used with any expansion RAM pack fitted, from 3K to 16K. This does however exclude Super-Expander because several of the programs are just too long for its memory capabilities. For more details on any Chalksoft product contact Chalksoft, Lowmoor Cottage, Tonedale, Wellington, Somerset TA21 0AL.

KOBRA ATTACKS OFFICE

Attacking the problems of wordprocessing enhancements, Kobra have introduced SpellPro and MailPro. Fully compatible with PaperClip, Kobra's word processing package for the Commodore 8000, 64 and WordPro, these two new packages extend the usefulness of PaperClip to cover the entire requirements of office text automation.

SpellPro is a new and sophisticated spelling checking program and can be expanded to include up to 80,000 words. MailPro is capable of holding 4,000 records on a standard 8050 discette and can be used to provide powerful search and retrieve facilities of addresses and other records or data base type files.

SpellPro and MailPro, like PaperClip, each cost £149 for the Commodore 8000 and you can get more information from Kobra Micro Marketing, Farm Road, Henley-on-Thames, Oxon.

SNAKE IN THE GRASS

Serpentine is a new cartridge based game for the VIC-20. Not for the weak-kneed among you, the action takes place in a snake pit where the player, as a small snake, has to avoid larger hungry snakes. The snake can grow by eating frogs which appear from time to time or by eating the tail segment of the other snakes. You can get bigger and it would appear that the frogs eventually start eating the eggs that the snakes keep laying. It all seems somewhat involved and rather gruesome but at a price of £24.95 you may want more information so please write to Audiogenic Ltd, PO Box 88, Reading, Berkshire.

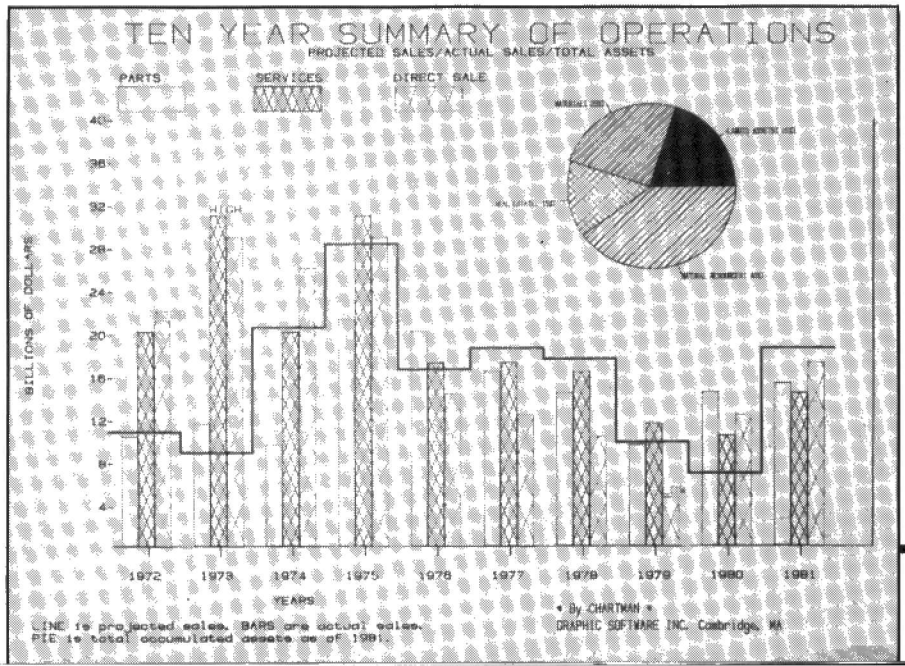
SHARP BUSINESS PRACTICE

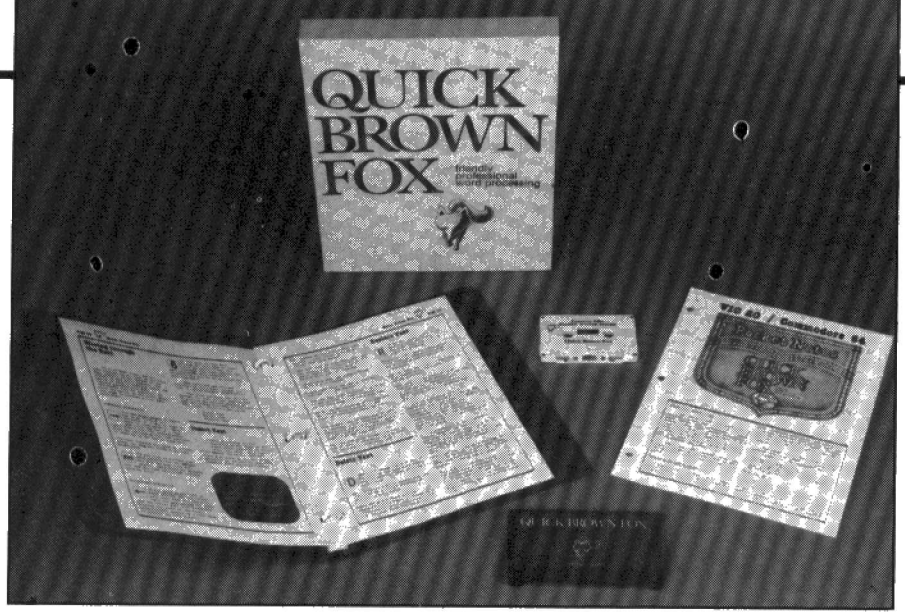
Sharp have announced the launch of six programs for their MZ-80A microcomputer: Directory, Price List, Sales Ledger, Purchase Ledger, Invoicing and Stock Control. All programs come with a comprehensive user manual and will run on the unexpanded MZ-80A. Each program is self-contained but has been designed to integrate into a complete system giving a comprehensive range of features which can be built up according to the user's needs. To allow even greater flexibility of operation and increased capacities Sharp are proposing upwards compatibility to the disc based system.

Each tape is priced at £19.95 and you can get more information by writing to Sharp Electronics (UK) Ltd, Sharp House, Thorp Road, Manchester M10 9BE or ring 061-205 2333.

◂ DRAWING THE LINE

A business graphics package called Chartman designed specifically for the IBM PC has been introduced by Bonsai. Chartman will produce high resolution bar charts, two and three dimensional pie charts and logarithmic line charts, text pages and signs. These graphics can be displayed on a screen, printed on a graphics printer and plotted onto





paper or transparencies. Chartman is menu driven and once charts have been created they can be stored and retrieved and edited later.

Chartman I displays everything on the screen in monochrome high resolution, prints charts on the IBM PC printer or Epson MX80 and 100 printers (all need the Epson Graftrax option) and can plot on HP7470 two-pen and HP7220 eight-pen plotters and costs £295. Chartman II has all the features of Chartman I plus it can display charts in colour on RGB monitors, can print colour charts on IDS Prism colour printers and can plot on IBM XY750 plotters and costs £395. For more information please write to Bonsai Ltd, 112-116 New Oxford Street, London WC1A 1HJ or ring 01-580 0902.

RAGS TO RICHES

Who wants to be a millionaire? Well at least you can practise by playing Millionaire, a stock market simulation which is based on random numbers as well as actual stock market trends. At the start of each game the computer creates a unique 91 month market environment and you start in the 14th week with historical stock prices for 15 different companies and the industry averages for four different types of businesses. You don't get to keep all the money you make though as when you buy or sell you have to pay broker's commission and if you make any money the taxman will take his share too.

Claimed as an educational tool as well as a game that is not easy to win Millionaire is priced at £69.95 for the IBM PC version and £59.95 for the Apple II version. For more details contact Pete & Pam Computers, New Hall Hey Road, Rossendale, Lancashire BB4 6JG or 'phone 0706-227011.

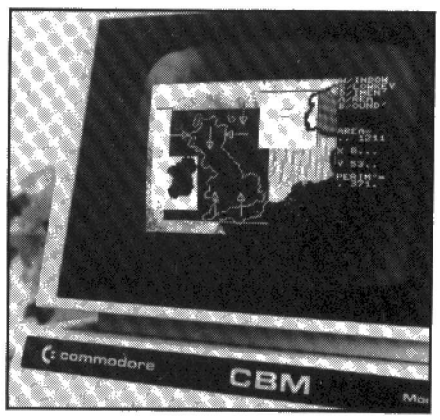
FOXY COMMODORE ▲

The Quick Brown Fox word processing package is available for the VIC-20 and Commodore 64. Some of its features include full editing ability, automatic reformatting of edited text, all commands are logical requiring single key operation, it is based on a new design concept that supports a wide variety of printers, takes up less computer memory than a lot of other word processing packages, memory can be added in 4K increments up to 16K, and it can send and receive information from one computer to another via built-in telecommunications facilities.

Quick Brown Fox costs £60 and comes from SPT Electronics Limited, Tollesbury, Essex CM9 8SE and you can 'phone them on 0621-868484.

BEAUTIFUL IMAGERY ▼

Digithurst are expanding their range of microcomputer based image processing software by adding a graphics package MicroScale to their MicroSight vision systems. MicroScale allows the user to define windows in the captured image; these windows can be processed and various attributes such as area and perimeter of objects within them can be determined. MicroScale has access to routines within MicroSight software that can for example carry out such tasks as edge enhancement of Grey Scale images.



The graphics package which comes fully documented can be expanded to allow captured images to be merged with CAD drawings. MicroScale packages are available from £295 plus VAT and complete MicroSight systems from £495 plus VAT. More information can be obtained from Digithurst Limited, Leaden Hill, Orwell, Royston, Hertfordshire SG8 5QH or 'phone 0223-208926.

BRIEFING

Driving can be a dangerous business but at least it won't be fatal if you play **Hazard Run** on your 16K Atari. Available on cassette or disc the game needs a joystick and is priced at £21.50 on cassette or £24.95 on disc, including VAT. More details are available from **Allrian Data Services,** 1000a Uxbridge Road, Hayes, Middlesex UB4 0RL or 'phone 0753-5201.

Apple Panic is a new game for the VIC-20: a workman is besieged by a number of wandering apple monsters as he climbs ladders to different levels on the screen. The only way to destroy the apple monsters is to dig holes in the brick floors. Available as a cartridge for £24.95 the game is supplied via the nationwide dealer network or by **Audiogenic,** PO Box 88, Reading, Berkshire.

The **EDG Graphics Package** constitutes an advanced picture drawing system controlled entirely by normal keyboard input and uses cassette tapes for software and picture storage. For use with the BBC Microcomputer Model B, the cassette comes with a manual and costs £24.95. It is available by mail order from **Salamander Software** (or normal retail outlets) at 17 Norfolk Road, Brighton, Sussex BN1 3AA or 'phone 0273 771942.

The **Video Palace,** one of London's biggest stockists of video and computer software, is extending its computer retailing division with entry into mail order sales. A quarterly catalogue will be mailed to computer enthusiasts throughout the country and all items in the catalogue will be available directly from the Video Palace at the normal retail price. Full details are available from The Video Palace, 62-64 Kensington High Street, W8 by sending a 25p postal order/cheque with a large SAE.

SERIOUS 64 PROGRAMS

We don't believe that the 64 is just a games machine, and here's the software to prove it!

BUSICALS — another spreadsheet! At last there's a spreadsheet program that's so simple, you won't need a degree in Computing to understand it. BUSICALS will allow you to juggle figures to your heart's content — and won't confuse with clever functions that you don't need. BUSICALC costs £39 on tape, £40.50 on disk, and is also available for PET and VIC (with 16K expansion).

BUSIWRITER — word processing If you don't need the ultimate sophistication of VIZAWRITE (£69 — disk only), you ought to take a look at BUSIWRITER. It allows you to write, edit, format and print your text — and will even perform simple calculations! You can buy BUSIWRITER on disk for just £39, or in a cartridge for £49. Both versions will save text to disk or to tape.

VICTREE — programming aid Add over 40 commands to Basic including advanced toolkit functions and Basic 4 style commands. The VICTREE module costs £65 including a comprehensive 100 page manual.

MIKRO — 6502 assembler & monitor Why buy an assembler rather than a monitor? Because you probably don't write perfect machine code programs. With MIKRO you can make corrections to your source code and reassemble it at lightning speed (about 20 seconds for 2K of machine code!) The MIKRO cartridge costs £50.

P.S. WE ALSO SELL GAMES We put the colour and excitement into our games, not our adverts. All our arcade games are in machine code with full colour and sound: already available are TANK ATAK, MANGROVE, and KAKTUS, and by the time you read this we should have STIX (similar to QIX) and CRAZY KONG ready. All cost just £8 each on cassette. We specialise in adventure and fantasy games: COSMIC CAPERS, GOBLIN TOWERS, and THE CRACKS OF FIRE are £12 each.

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Mike Boulton

ATARI RENUMBER

Our article on ideas for the Atari range of micros prompted this renumbering routine.

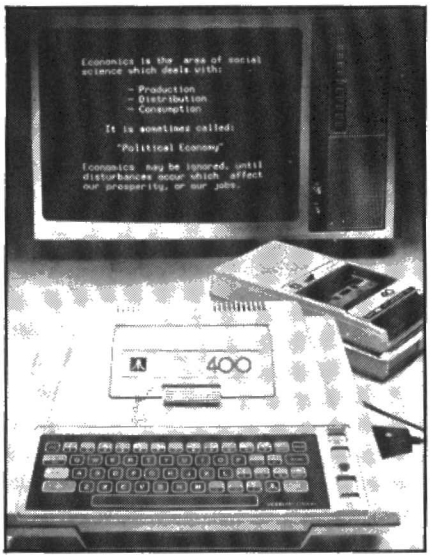
Having read the article in the March issue on Atari BASIC, which I found most revealing, I've had a crack at a renumber routine. The program as listed works — I've used it on several of my own programs then RUN them and they still work.

The routine renumbers all GOTOs, GOSUBs, RESTOREs, ONs and TRAPs in single- and multi-statement lines, including those after IF . . . THEN. It will not, however, deal with statements such as GOTO N *1000 (which it will ignore) or GOTO 1000 *N (which it will treat in the same way as GOTO 1000). After sorting out the line numbers within lines, it finishes off by renumbering the program lines.

It is not particularly quick — the longest program I have used it on is a 20K spaghetti-like spelling program which it renumbers in 19 minutes — but it's a lot better than doing it yourself.

I have used as few constants as possible in the interests of memory conservation and I have also tried to stick to commonly-used variable names so as not to overload the variable table of any program it is tacked on to for renumbering. The coding uses 2589 bytes and it takes another 162 bytes to run.

After typing in, the routine should be LISTed to disc or cassette. It can then be ENTERed on top of the program to be renumbered. Type GOTO 32000 to set it going.



LINES	FUNCTIONS
32010 to 32060	Sets up eight equidistant markers along the program to be renumbered — this saves search time in lines 32220 to 32240 (before I put this bit in, it took two hours to renumber a 20K program.
32070	Input of starting number and interval between lines.
32080 to 32150	Tests for GOTO,GOSUB,RESTORE,ON,TRAP,IF.
32180	Tests to see if numerical constant follows GOTO, GOSUB, etc.
32190 to 32210	Converts six byte BCD into decimal number (line number after GOTO, etc.)
32220 to 32240	Moves along markers set up at beginning of routine till it finds section of code in which line number occurs.
32250 to 32270	Searches section of code for line number and counts number of lines till it finds it.
32280 to 32350	Calculates new line number, converts it back to six byte BCD number and POKEs it in.
32360 to 32430	Routine to find THEN in statements beginning with IF and then checks for GOTO, etc.
32440 to 32470	Routine to renumber program lines.
32480 to 32490	Routine to move on to next statement in multi-statement line.

Table 1. Breakdown of the listing.

```
32000 A=1:B=A+A:C=A+B:D=B+B:E=B+C:F=C+C:G=C+D:H=D+D:I=D+E:J=E+E:K=J*J:L=K*K:M=25
6:DIM L(H,B)
32010 LN=Z:S=PEEK(136)+M*PEEK(137):A1=PEEK(S)+M*PEEK(S+A):L(LN,Z)=A1:A2=PEEK(144
)+M*PEEK(145)-2589:A4=S:P=Z
32020 GRAPHICS Z:POKE 752,A:POSITION C,D:? "Initialising..";L(LN,A)=S
32030 A3=PEEK(S+B):S=S+A3:A1=PEEK(S)+M*PEEK(S+A):P=P+A:IF S-A4>((A2-A4)/H)*LN TH
EN 32050
32040 GOTO 32030
32050 LN=LN+A:L(LN,Z)=A1:L(LN,A)=S:L(LN,B)=P:IF LN=G THEN 32070
32060 GOTO 32030
32070 POSITION C,D:? "Input starting number",:INPUT T:POSITION C,G:? "Input inte
rval",:INPUT U
32080 L(H,Z)=32000:L(H,A)=A2:S=PEEK(136)+M*PEEK(137)
32090 POSITION C,J:? "Amending line "
32100 Q=PEEK(S+B):R=PEEK(S+C):P=S:IF PEEK(S)+M*PEEK(S+A)=L(H,Z) THEN 32440
32110 POSITION J+G,J:? PEEK(S)+M*PEEK(S+A)
32120 IF PEEK(P+D)=E*G THEN 32180
32130 IF PEEK(P+D)=G THEN 32360
32140 IF PEEK(P+D)>I AND PEEK(P+D)<J+D THEN 32180
32150 IF PEEK(P+D)=C*J THEN P=P+B:Q=A:GOTO 32190
32160 IF Q<>R THEN 32480
32170 S=S+Q:GOTO 32100
32180 IF PEEK(P+E)<>J+D THEN 32480
32190 N=PEEK(P+F)-H*H:A2=PEEK(P+G):A3=PEEK(P+H):A4=PEEK(P+I):N1=INT(A3/(D*D)):N1
=N1*J+(A3-N1*D*D):N1=N1/K
32200 N2=INT(A4/(D*D)):N2=N2*J+(A4-N2*D*D):N2=N2/L
32210 N3=INT(A2/(D*D)):A2=N3*J+(A2-N3*D*D):A2=A2+N1+N2:N=K^N*A2:IF N<>INT(N) THE
N N=INT(N)+A
32220 X=PEEK(136)+M*PEEK(137):LN=Z:A1=PEEK(X)+M*PEEK(X+A)
32230 IF N>=L(LN,Z) THEN LN=LN+A:GOTO 32230
32240 A1=L(LN-A,A)
32250 A2=PEEK(A1)+M*PEEK(A1+A):A3=PEEK(A1+B):IF A2=N THEN 32280
32260 A4=A4+A:A1=A1+A3:IF A2>=L(H,Z) THEN 32170
32270 GOTO 32250
32280 N=A4*U+T+L(LN-A,B)*U:V=INT(N/L):IF V>Z THEN 32340
32290 V=INT(N/K):IF V>Z THEN 32330
32300 A1=H*H:A2=INT(N/J):A2=A2*D*D+(N-A2*J):A3=Z:A4=Z
32310 POKE P+F,A1:POKE P+G,A2:POKE P+H,A3:POKE P+I,A4:IF Q=A AND PEEK(P+J+B)=J+H
 THEN P=P+H:GOTO 32190
32320 Q=Z:GOTO 32160
32330 A1=F*J+E:A2=INT(V/J):A2=A2*D*D+(V-A2*J):W=N-(V*K):A3=INT(W/J):A3=A3*D*D+(W
-A3*J):A4=Z:GOTO 32310
32340 A1=F*J+F:A2=V:W=N-(V*L):Y=INT(W/K):A3=INT(Y/J):A3=A3*D*D+(Y-A3*J)
32350 W=W-(Y*K):A4=INT(W/J):A4=A4*D*D+(W-J*A4):GOTO 32310
32360 FOR X=P+G TO P+R:IF PEEK(X)=D*I THEN 32380
32370 NEXT X:GOTO 32480
32380 IF PEEK(X+A)=J+D THEN 32420
32390 IF PEEK(X+B)>I AND PEEK(X+B)<J+D THEN R=PEEK(X+A):GOTO 32420
32400 IF PEEK(X+B)=E*G THEN R=PEEK(X+A):GOTO 32420
32410 GOTO 32370
32420 FOR V=X TO X+C:IF PEEK(V)=J+D THEN P=V-E:GOTO 32190
32430 NEXT V:GOTO 32480
32440 POSITION C,B*G:? "Changing line numbers - line ";S=PEEK(136)+M*PEEK(137)
32450 R=INT(T/M):D=T-M*R:POSITION H*D,B*G:? T:IF PEEK(S)+M*PEEK(S+A)=L(H,Z) THEN
 32470
32460 POKE S,D:POKE S+A,R:S=S+PEEK(S+B):T=T+U:GOTO 32450
32470 POSITION C,J+H:? "Line numbers finished at ";T:END
32480 IF Q=R THEN GOTO 32160
32490 P=S+B:R=PEEK(P):P=P-D:GOTO 32120
```

Listing 1. The Atari renumbering routine.

NEXT MONTH

computing today

AUGUST ISSUE ON SALE JULY 8th

PLANETFALL

Are you astute enough to be able to control an intergalactic trading fleet? You might think so but with space pirates, random checks by officials and the everpresent threat of being beaten to the next planet by another crew this game makes Monopoly look like kids' stuff! Quite apart from bringing you a version of this superb game we show you just how we did it. In another of *Computing Today's* giant program features we explain the workings of the game and show you how to convert it onto many of the popular systems around today. For those who like to think about the games they play rather than just sit and zap aliens then Planetfall is a real challenge of strategy and commercial planning. Who knows, one day you really might be boss of the Intergalactic Business Megacorporation!

PUZZLED BY IT ALL?

Do you remember those problems they used to set at school (and probably still do for all I know) which went along the lines of "Bill has twice as much money as John who has twice as much as Bert. They find a £10 note and share it so they all end up having equal amounts. How much did John have to start with"? Bet you couldn't solve them either! The tricks one can use to deal with imaginary problems like these and their very real day-to-day counterparts forms the basis of a new six-part series starting in next month's issue. All the programs and examples are written for the ZX Spectrum so should prove very simple to adapt to other systems, even more useful is the fact that you'll be able to crib the answers from your children who'll also find the series very educational.

GET IN THE GROOVE

Not, we hope, literally but with a new disc drive for your Dragon 32! If you've outgrown the cassette system of your Dragon 32, and who hasn't, then what can you do to expand? Well, we've been testing a new disc unit for the system which appears to be a real winner. Although it uses its own operating system rather than one of the 'standards' such as Flex, it appears to have everything the average disc user will need to speed up program and data storage The price is reasonable, it's British made and available now, all of which may have you asking the question "So, what's the catch?". Next month we'll reveal the identity of the unit and you'll be able to find out if we discovered any problems in using it with our Dragons.

A CUT ABOVE THE REST

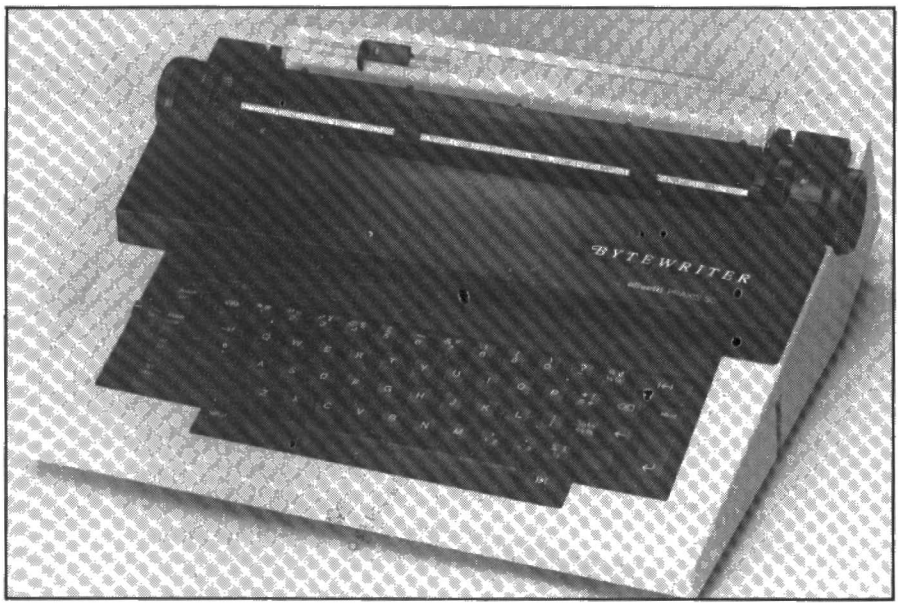
Well, with a name like Sord they must be used to puns by now! Among the latest batch of micros to invade our shores from the land of the rising sun is the diminutive Sord M5, a system that looks not dissimilar to the ZX Spectrum in many respects. Sord may hardly be a household name here (yet, that is) but in Japan they are BIG in the world of micros and consumer electronics. The system is certainly built to a very high specification, one wishes the same could be said for the manuals, but the real question seems to be why one should pay out money for a small capacity but well built computer as opposed to a bigger capacity but maybe not so well thought out one. Next month we'll be bringing you the results of our in-depth testing and we may be able to answer the question too!

Articles described here are in an advanced state of preparation but circumstances may dictate changes to the final contents.

Richard Marks

SPECIAL REPORT #1

A daisywheel typewriter than can be interfaced to a microcomputer — too good to be true? We take a look.



The advertisements claim that buying the Olivetti Praxis 30 is like getting a free typewriter with your computer printer! The Praxis 30, also known as the Bytewriter, consists of an Olivetti daisywheel typewriter with an interfacing system which can connect to a large variety of computers. At under £500, it is within the reach of many potential buyers, some of whom would have considered a dot-matrix printer instead. What does it have to offer for the money?

WHAT TYPE OF BEAST

Firstly, I looked at it purely as a typewriter, and was very impressed with its performance. It measures 15 by 14 inches, which means it will fit comfortably on a small desk. It looks both professional and attractive when you take it out if its box. It is well styled, with keys that have a proper feel and are well spaced. The widest paper it will accept is 12 inches, which is wide enough for a sheet of A4 to go in sideways.

The whole thing comes in a carrying case which looks like a large briefcase, and together they weigh 10kg, which means it can easily be carried about, with one hand! It was supplied with a mains plug , and there is ample space inside the case for the plug and lead. The mains lead is eight feet long, which seems to be long enough but never is in practice. The plug was fitted with a 13 amp fuse, which is a bit odd as its power consumption is only 50 watts.

Some of the keys have multiple functions: there is a slider switch which determines which set is selected. These are generally keys which aren't used much in letter writing, as you can see on the illustration. If, however, you intend to use the machine for listing BASIC programs, you may get a nasty shock, as there will be discrepancies in some of the characters. For example; the plus and exclamation marks are both acessed by the same key, and short of sliding the selector switch back and forth I can see no way of getting sensible listings. A particular problem seems to be printing an exclamation mark, which appears as an apostrophe.

The margins and tabs are all set by push buttons, which saves you rummaging around at the back of the machine. It is possible to not only set up tabs wherever you want but also, optionally, to print a vertical line at each tab, which would be useful for accountants and such people. An electronic bleep sounds when you are approaching the end of a typed line, at the margin stop, and also if you attempt to set margins or tabs in ridiculous places.

There is also the facility for automatic deletion of typing errors at the push of a button. Depending on your ribbon, this can be done by lifting the old character off the paper or by overprinting with white. The machine has a memory for the last 10 characters typed, and can delete any of these automatically. You can also relocate the print head after doing your crossings-out ready to recommence typing by pressing the Relocate button.

So all in all, my impression was that this is a good electronic typewriter, with all the usual knobs and gadgets that one would expect, with the exception of a paper support. And that isn't necessary either.

The quality of the type has to be seen first hand to be described. Let it suffice to say that even a ham-fisted typist could produce a clean, crisp copy using this machine. The use of the correction tape cannot be seen, and a letter typed on this machine looks a good as any you will see and better than most.

The machine has a memory so that if you can type faster than it can print, it will remember your letters. This feature only comes into its own when you press the Carriage Return: you can then continue to type during the half-second it takes for it to move back.

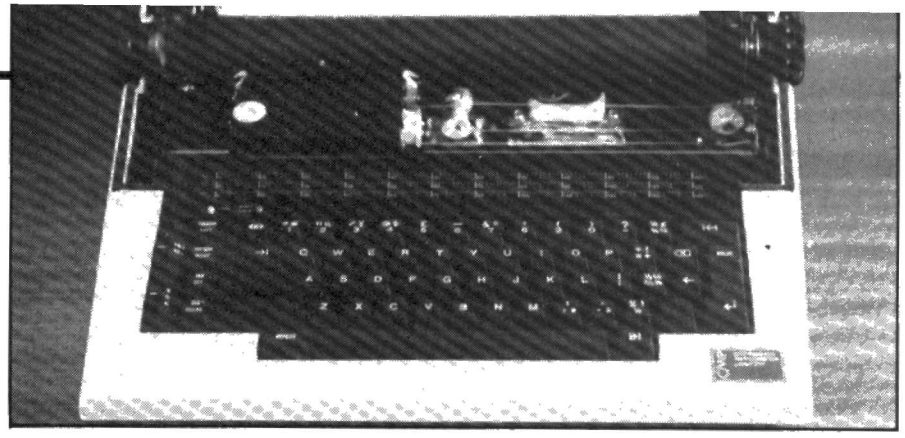
If you want to use it as a computer printer and not merely a classy electric typewriter you come across a number of little problems, which are a bit of a pain. The first problem you have is finding a reliable supplier, and I found only a few places that I felt knew what they were talking about. Business machine suppliers seemed pretty clueless about the whole thing, and some of the computer shops weren't much better either. The next problem was to interface it.

INTERFACING THE PROBLEM

The machine is available with either an RS232 or Centronics interface — the latter is slightly cheaper and suited my machine. The engineer looked at me darkly when I asked for a Standard Centronics, and asked "Which standard?"

It transpires that there is not a single standard interface but a variety. My Olivetti works well enough with a TRS 80 but with one proviso — it constantly sends the computer an 'out of paper' signal. Investigations revealed that pin 23 on the Centronics, which deals with the presence or absence of paper, was set to be constantly high, when it should have been low. I had the same problem using an Apple II, and presumably would do with other computers.

It needed a few minutes work with a soldering iron to get round this problem. I have discovered that this can sometimes be done under ▶



software control — for example WordStar can be adapted using the INSTALL routine, but a hardware fix has the virtue of permanence. If you have reservations about tampering like this, you could insist that your supplier performs the necessary modifications, which reinforces my point about choosing a 'clued-up' supplier.

GETTING IT IN PRINT

With my interface installed and word processing package running, I started to print my first pages. It is always a fascinating spectacle to see your own writing appearing in print, but particularly so with this printer, because the quality of the printing was so good. Printouts from this machine are of a quality that leaves dot-matrix printers miles behind. You could use this for writing any important document, and could be sure that your letter will impress the recipient.

As it continued to print, however, I became aware of the passage of time. It is said to print at 12 characters per second, and it seems to take four or five minutes to type a sheet of A4. This is really quite slow if you have any long manuscripts to produce, but is fast enough for most uses.

You have a problem if your printing runs to more than one sheet of paper, since the typewriter has no way of detecting whether or not it has paper in it, and will merrily plough on. Suitable software will allow you to halt every so often. It is also possible to use continuous paper and slice it into sheets later.

When used with a computer, I discovered that the typewriter keyboard is not disabled, and it is possible to type simultaneously, resulting in a bit of a mess. More important is the fact that the computer cannot override the preset margin limits, and if it tries to do so the typewriter will win, and half your copy will be lost.

The machine comes with its ribbon in a cartridge. It is understandable that different manufacturers will use different cartridges, and there's not much one can do about this, but it could potentially give you a problem with obtaining supplies. The ribbon supplied is a carbon film, which gives the best results but can only be used once. I had a nasty shock when my first ribbon ran out after printing only a dozen sheets of paper.

At nearly two pounds a go for a capacity of 40,000 characters, there are definite advantages in using fabric ribbons, which have a capacity of ten times as much, and saving the carbon for special occasions.

Changing the ribbon is actually surprisingly fiddly, and again the manual isn't a great deal of help. The daisy wheel is quite easy to change if you have been shown how. If you try and make sense of the drawings in the manual you will probably never change it, and you'll probably be unable to find anything. The daisy wheels are interchangeable with all other Olivetti wheels, and come in three type sizes. To change the daisy wheel you need to remove the ribbon first, which is a nuisance. It can be changed then in just a few seconds, and if you want you can change the daisywheel in the middle of a page without leaving a smudge on the paper.

The machine is made in Japan (surprise), but the interface circuitry is not fitted there. In fact, British Olivetti deny all connections with any interfacing, and became a little shirty when I asked them for details. They have no control over what happens to the machine when it leaves them, and the machine plus interface is distributed by a company called DISCOM in Evesham. Where this places you regarding servicing I am not fully clear, but once again the folly of purchasing from a cowboy becomes apparent.

The manual supplied with the machine is written in Italian, English, German, French and Spanish, and sometimes it isn't totally clear which one of these you are reading! The layout is different once again for the American version, which has different legends on many of the keys. The manual is a bit incomprehensible at first reading, and honestly it doesn't improve. It starts by telling you that you should move the ON/OFF switch to ON, which is fine, but doesn't tell you the bits of packaging you need to remove to allow the daisy wheel to move freely. If you don't do this, the machine will do nothing but groan when you plug it in.

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An example of the type

IN CONCLUSION

In summary then, Olivetti have produced a top-notch portable typewriter. The computer interface opens it to a wider market, and when used in conjunction with a word processing package, it is capable of producing first rate results. It seems odd that it has taken so long for manufacturers to catch on to this combination, which can't be much more expensive to produce than a straightforward typewriter, and I would predict it will be the first of many imitations.

The quality of the printing is good enough for any professional use. The machine uses any type of paper, envelopes or labels, and can be used with most computers.

The only drawback of note is the slow speed — but it's still a lot faster than I could type!

FACTSHEET	OLIVETTI PRAXIS 30
Face	Daisywheel
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Feed	Friction
Paper	Up to 12 inches width
Pitch sizes	10 12 15
Print speed	12 cps
Graphics	No
Power	115 or 240V. Factory preset.
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Software News

INNOVATIVE
BBC SOFTWARE
from the professionals

MOLIMERX EXPANDS INTO THE BBC!

Bexhill — June 1983

TODAY a spokesman for Molimerx Ltd., the TRS-80 Genie Software House of Bexhill, announced that they are entering the BBC Software market.

Until now, Molimerx have been supplying software for all of the Tandy machines plus all of the Genie microcomputers, some dozen machines in all. As they have been doing this for some 5 years, they have accumulated a vast number of programs — in the range of 400-500 in number. Molimerx will be translating all of their best existing programs together with publishing new programs specifically written for the BBC. They are hoping, therefore, to be releasing around six new programs per month for some time to come.

Their spokesman said today that where programs are going to be translated, the features unique to the BBC will be utilised to the maximum. Specifically Molimerx say that translations will not just be a code adaptation, but will also incorporate BBC features. They gave as an example the recently completed translation of Shuttle. This is a simulation of the Columbia space shuttle. In the TRS-80 version it is displayed in straight text. The BBC version, however, contains a coloured graphic representation of the ship.

The spokesman said that the main thrust will be towards new programs and Molimerx are actively soliciting new software from both their existing stable of 120 authors and are also searching for new qualified authors, experienced on the BBC machine.

Over the years, Molimerx have built up a catalogue of some 170 pages. The procedure is that an addition containing new software is published every 8 weeks or so. The existing index is discarded and the new addition contains a new up-dated index. The catalogue is punched for a ring binder; hence, customers always have a current and up to date catalogue. Molimerx say that this same procedure will be used for the new BBC software catalogue.

Owners of BBC machines, therefore, should write to Molimerx for a copy of their current catalogue. For at least a while, there will be no charge. Customers should send an A4 size stamped addressed envelope for 17p.

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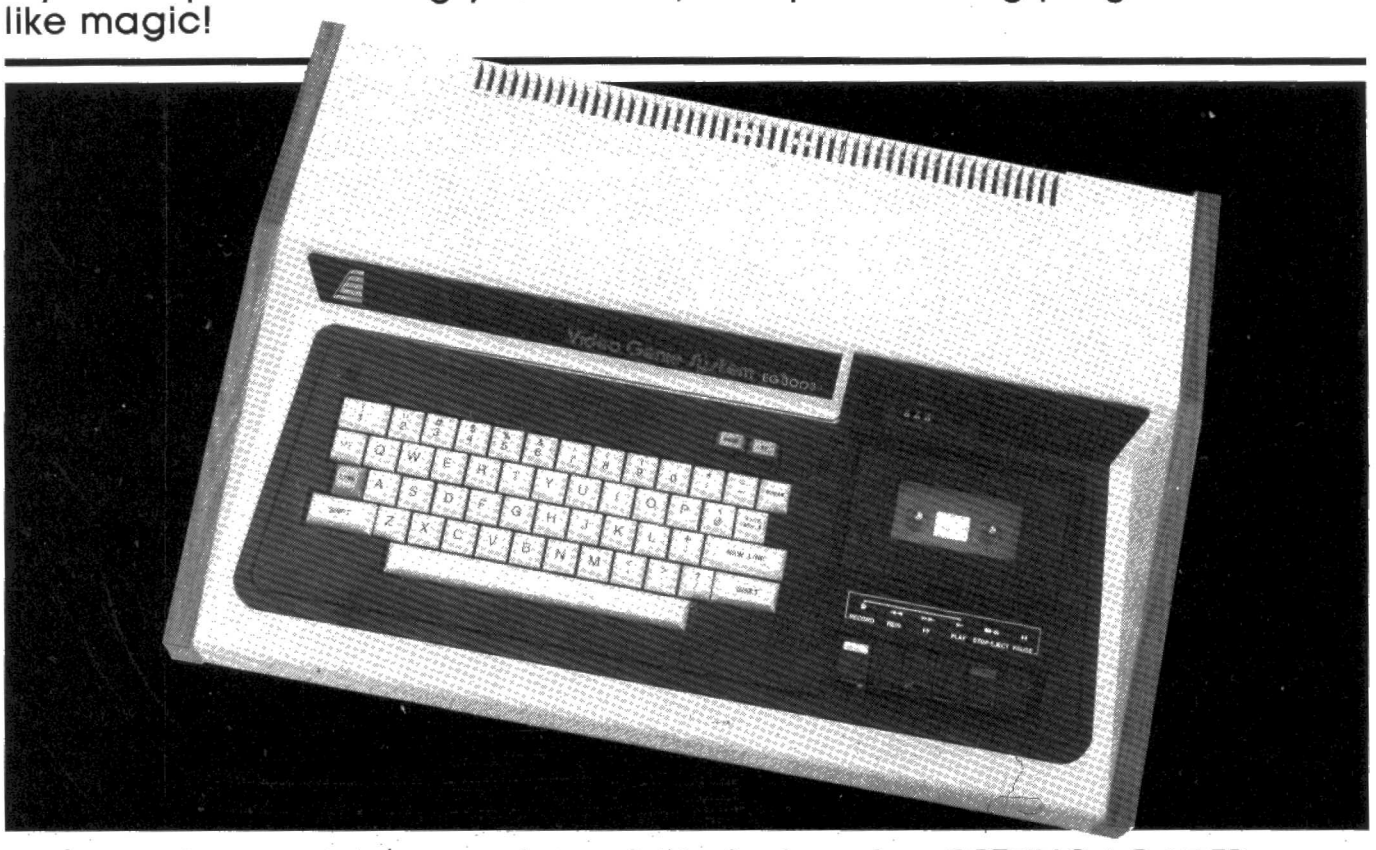
T A Franks

GENIE SPACE SAVER

If you keep overloading your Genie, this space saving program works like magic!



The present program started life out of necessity when one of my BASIC programs was extended so much that there was no longer room in memory to run it. The answer was obvious — all those REM statements and redundant spaces would have to go. Now, many commercially available 'toolkits' provide such a utility but lacking both a 'toolkit' and cash I rashly decided to write my own. My first few attempts were entertaining if not entirely successful! One version not only succeeded in deleting all the spaces in the program but also managed to place the end of the program at the beginning. In the version presented here, however, this has been dispensed with as an unnecessary frill!

RUNNING RULES

The program is designed to run on a 16K Genie and hence will presumably also run on a Model I TRS-80. It allows you the choice of either removing all redundant spaces (except those enclosed in quotation marks), or all REM lines, or both. It is possible to 'protect' remarks by placing quotation marks immediately after the word REM:

```
10  REM" LEAVE THIS LINE ALONE
```

Incidentally, this protection will not work if an apostrophe is used as a shorthand replacement for REM. The reason for this has caused me to re-think my own use of this so-called shorthand. Far from being a space-saver, this abbreviation actually requires three times as much memory as the word REM. In a program line the word REM is stored as the number 147, whereas the apostrophe takes three bytes and appears as a colon (code 58) followed by the code 147 followed by code 251. When searching to see if the REM line is protected, the computer therefore sees an apostrophe (251) following the REM code (147) and assumes the line is not protected. The moral is simple — it may be quicker to type ' than REM but it costs you in terms of memory. In practice the program removes only that part of the line following the code for REM so that any branches which are directed to that line are still valid. (This is bad programming practice but unfortunately it still persists.)

GETTING LOADED

In use, the program is loaded using the SYSTEM command and will start running automatically as soon as it is loaded. This miraculous state of affairs is brought about by causing the number 233 to be loaded into memory location 16866. Quite why this works is at present beyond me, but work it does! For those without an Editor/Assembler who are brave enough to attempt it, I have included a BASIC program which will load the machine code. If this is used then it must, of course, be loaded into memory ***before*** the program you wish to shorten is loaded. It may be entered simply by typing PRINT USR(0).

On starting you will be offered the three choices referred to earlier. In fact, there is a fourth choice, for at this stage, should you lose your nerve, you can still back down gracefully by typing 0. This will jump you back to command level with your program still intact. From this point onwards, however, only a system reset will release you from the grip of the utility before its allotted span is up. The hopes of finding your ▶

program in usable shape should you leave the routine in such an unorthodox way are slight!

PROGRAM POINTERS

I have built in the program a device to show that something is happening. In the top right hand corner of the screen two arrows (< and >) alternate each time a space or REM line is removed. I have found that this tends to impress the lay viewer more than the final effect of the program! The program ends unspectacularly by jumping back to command level with the usual 'READY'. It is possible to find out how many bytes of memory have been saved by typing PRINT PEEK (16452) + PEEK (16453) ★ 256. This incidentally, is part of an area of RAM used by disc BASIC for the TIME$ function.

My program is organised as a matter of convenience to start at address 32000, but with one alteration it is fully relocatable. This alteration is the address of TEXT included in line 19 of the listing. Otherwise, all jumps, etc are relative except the final jump back into BASIC at line 84. I now use this program regularly, keeping a back-up copy of each program with spaces and REMs intact, while using the slimmed-down version for everyday use.

```
                        SPACES
                        VERSION 2.0
                        13.3.83


                                ORG  32000         ORIGIN

                        SCREEN: EQU  3C3F          TOP RH CORNER
                        KEY:    EQU  4041          NORMALLY USED BY
                        ADDR1:  EQU  4042          DOS FOR TIME
                        ADDR2:  EQU  4044          FUNCTION

7D00  DD 21 00 00 START:LD   IX, 0         CLEAR MAIN COUNTER
7D04  CD C9 01          CALL 01C9          CLEAR SCREEN
7D07  21 E3 7D          LD   HL, TEXT      PROMPT MESSAGE
7D0A  CD A7 28          CALL 28A7          PRINT PROMPT
7D0D  CD 49 00  INPUT:  CALL 0049          INPUT KEY NO
7D10  FE 30             CP   48            ABORT IF ZERO
7D12  28 61             JR   Z, FINI
7D14  FE 31             CP   49            LESS THAN 1?
7D16  38 F5             JR   C, INPUT
7D18  FE 34             CP   52            GREATER THAN 3?
7D1A  30 F1             JR   NC, INPUT
7D1C  32 41 40          LD   (KEY), A      SAVE KEY NO...
7D1F  CD 33 00          CALL 0033          ...AND DISPLAY IT
7D22  3E 3C             LD   A, 60         DISPLAY ARROW
7D24  32 3F 3C          LD   (SCREEN), A   ON SCREEN
7D27  21 E9 42          LD   HL, 17129     START OF PROGRAM
7D2A  7E        NEWLN:  LD   A, (HL)       CHECK FOR
7D2B  23                INC  HL            END OF
7D2C  B6                OR   (HL)          PROGRAM
7D2D  28 46             JR   Z, FINI
7D2F  2B                DEC  HL            STORE ADDRESS OF
7D30  22 42 40          LD   (ADDR1), HL   CURRENT LINE
7D33  23                INC  HL            MOVE ON
7D34  23                INC  HL            TO FIRST
7D35  23                INC  HL            BYTE
7D36  23        NXTBYT: INC  HL
7D37  7E        GETBYT: LD   A, (HL)       GET BYTE INTO A
7D38  FE 20             CP   32            IS IT A SPACE?
7D3A  28 2A             JR   Z, SPACE
7D3C  FE 22             CP   34            IS IT QUOTES?
7D3E  28 0B             JR   Z, QUOTES
7D40  FE 93             CP   147           IS IT REM?
7D42  28 13             JR   Z, REM
7D44  FE 00             CP   0             END OF LINE?
7D46  28 EE             JR   NZ, NXTBYT    GO FOR NEXT BYTE
7D48  23        ENDLIN: INC  HL
7D49  18 DF             JR   NEWLN         GO FOR NEXT LINE

7D4B  23        QUOTES: INC  HL
7D4C  7E                LD   A, (HL)
7D4D  FE 22             CP   34            END OF QUOTES?
7D4F  28 E5             JR   Z, NXTBYT
7D51  FE 00             CP   0             END OF LINE?
7D53  28 F3             JR   Z, ENDLIN
7D55  18 F4             JR   QUOTES        REPEAT IT

7D57  3A 41 40  REM:    LD   A, (KEY)      REM TO BE
7D5A  FE 31             CP   49            LEFT IN?
7D5C  20 30             JR   NZ, REMOUT
7D5E  23        REM1:   INC  HL
7D5F  7E                LD   A, (HL)
7D60  FE 00             CP   0             END OF REM LINE?
7D62  20 FA             JR   NZ, REM1
7D64  18 E2             JR   ENDLIN

7D66  22 44 40  SPACE:  LD   (ADDR2), HL   SAVE ADDRESS
7D69  3A 41 40          LD   A, (KEY)      SPACES TO BE
7D6C  FE 32             CP   50            LEFT IN?
7D6C  FE 32             CP   50            LEFT IN?
7D6E  28 C6             JR   Z, NXTBYT
7D70  01 01 00          LD   BC, 1         NO OF BYTES TO REMOVE
7D73  18 30             JR   CLOSE

7D75  2A F9 40  FINI:   LD   HL, (16633)   END OF PROGRAM ADDRESS
7D78  22 FB 40          LD   (16635), HL   RESTORE VAR POINTER
7D7B  DD 22 44 40               LD   (ADDR2), IX   NO OF BYTES SAVED
7D7F  3E C9                     LD   A, 201        CANCEL AUTO-
7D81  32 E2 41                  LD   (16866), A    START
7D84  C3 66 00                  JP   0066          RETURN TO BASIC

7D87  2A 44 40  DONE:   LD   HL, (ADDR2)   RECOVER ADDRESS
7D8A  DD 09             ADD  IX, BC        ADD BYTES SAVED
7D8C  18 A9             JR   GETBYT

7D8E  01 00 00  REMOUT: LD   BC, 0         INITIALISE COUNTER
7D91  23                INC  HL
7D92  7E                LD   A, (HL)
7D93  FE 22             CP   34            NEXT BYTE=QUOTE MARKS?
7D95  28 C7             JR   Z, REM1       YES - LEAVE REM IN
7D97  FE 00             CP   0             END OF LINE?
7D99  28 AD             JR   Z, ENDLIN
7D9B  22 44 40          LD   (ADDR2), HL   SAVE ADDRESS
7D9E  03        NBYTE:  INC  BC            INCREMENT BYTE COUNTER
7D9F  23                INC  HL            GO TO NEXT BYTE
7DA0  7E                LD   A, (HL)
7DA1  FE 00             CP   0             END OF LINE?
7DA3  28 F9             JR   NZ, NBYTE

7DA5  EB        CLOSE:  EX   DE, HL        CALCULATE NUMBER
7DA6  2A F9 40          LD   HL, (16633)   OF BYTES TO
7DA9  AF                XOR  A             BE MOVED BY LDIR
7DAA  ED 52             SBC  HL, DE
7DAC  C5                PUSH BC            SAVE BYTE COUNT...
7DAD  C5                PUSH BC            ...TWICE
7DAE  44                LD   B, H          SET UP BC
7DAF  4D                LD   C, L          FOR LDIR
7DB0  2A 44 40          LD   HL, (ADDR2)   RECOVER ADDRESS
7DB3  D1                POP  DE            BYTE COUNT INTO DE
7DB4  19                ADD  HL, DE        SET UP HL FOR LDIR
7DB5  ED 5B 44 40       LD   DE, (ADDR2)   SET UP DE FOR LDIR
7DB9  ED B8             LDIR               REMOVE UNWANTED BYTE(S)
7DBB  2A F9 40          LD   HL, (16633)   END OF PROGRAM POINTER
7DBE  C1                POP  BC            RESTORE BYTE COUNT
7DBF  3A 3F 3C          LD   A, (SCREEN)   EXCHANGE ARROWS
7DC2  EE 02             XOR  2             ON THE
7DC4  32 3F 3C          LD   (SCREEN), A   SCREEN
7DC7  AF                XOR  A             CALCULATE NEW END
7DC8  ED 42             SBC  HL, BC        OF PROGRAM
7DCA  22 F9 40          LD   (16633), HL   POINTER
7DCD  2A 42 40          LD   HL, (ADDR1)   START OF LINE
7DD0  5E        NXTADD: LD   E, (HL)       GET ADDRESS OF
7DD1  23                INC  HL            NEXT LINE...
7DD2  56                LD   D, (HL)
7DD3  7A                LD   A, D          CHECK FOR END
7DD4  B3                OR   E             PROGRAM
7DD5  28 B0             JR   Z, DONE
7DD7  EB                EX   DE, HL        GET ADDRESS OF
7DD8  AF                XOR  A             NEXT LINE...
7DD9  ED 42             SBC  HL, BC        AMMEND IT...
7DDB  EB                EX   DE, HL
7DDC  2B                DEC  HL
7DDD  73                LD   (HL), E       ...AND REPLACE IT
7DDE  23                INC  HL
7DDF  72                LD   (HL), D
7DE0  EB                EX   DE, HL
7DE1  18 ED             JR   NXTADD

7DE3  52 45 4D 4F TEXT: DB   "REMOVE:-", 13
7DE7  56 45 3A 2D
7DEB  0D
7DEC  31 2E 20 53       DB   "1. SPACES", 13
7DF0  50 41 43 45
7DF4  53 0D
7DF6  32 2E 20 52       DB   "2. REMS",   13
7DFA  45 4D 53 0D
7DFE  33 2E 20 42       DB   "3. BOTH",   13
7E02  4F 54 48 0D
7E06  20 20 20 20       DB   "     ? ",   0
7E0A  20 3F 20 00

                        ORG  16866         CAUSES SYSTEM PROGRAM
41 E2 E9        AUTOST: DB 233             TO START AUTOMATICALLY

                        END
```

Listing 1. The Genie Space Saver program

```
  1  REM" ** VIDEO GENIE SPACE SAVE (LOADER)
  2  REM" ** BY T A FRANKS
  3  REM"
 10  X=32000:S=0
 20  FOR I=0 TO 269:READ A:POKE X+I,A:S=S+A:NEXT I
 30  IF S<>25795 THEN PRINT "** ERROR IN DATA **":GOTO 60
 40  POKE 16526,0:POKE 16527,125
 50  PRINT "** SPACE SAVER LOADED **"
 60  END
 70  DATA  221,  33,   0,   0, 205, 201,   1,  33, 227, 125
 80  DATA  205, 167,  40, 205,  73,   0, 254,  48,  40,  97
 90  DATA  254,  49,  56, 245, 254,  52,  48, 241,  50,  65
100  DATA   64, 205,  51,   0,  62,  60,  50,  63,  60,  33
110  DATA  233,  66, 126,  35, 182,  40,  70,  43,  34,  66
120  DATA   64,  35,  35,  35,  35, 126, 254,  32,  40,  42
130  DATA  254,  34,  40,  11, 254, 147,  40,  19, 254,   8
140  DATA   32, 238,  35,  24, 223,  35, 126, 254,  34,  40
150  DATA  229, 254,   0,  40, 243,  24, 244,  58,  65,  64
160  DATA  254,  49,  32,  48,  35, 126, 254,   0,  32, 250
170  DATA   24, 226,  34,  68,  64,  58,  65,  64, 254,  50
180  DATA   40, 198,   1,   1,   0,  24,  48,  42, 249,  64
190  DATA   34, 251,  64, 221,  34,  68,  64,  62, 201,  50
200  DATA  226,  65, 195, 102,   0,  42,  68,  64, 221,   9
210  DATA   24, 169,   1,   0,   0,  35, 126, 254,  34,  40
220  DATA  199, 254,   0,  40, 173,  34,  68,  64,   3,  35
230  DATA  126, 254,   0,  32, 249, 235,  42, 249,  64, 175
240  DATA  237,  82, 197, 197,  68,  77,  42,  68,  64, 209
250  DATA   25, 237,  91,  68,  64, 237, 176,  42, 249,  64
260  DATA  193,  58,  63,  60, 238,   2,  50,  63,  60, 175
270  DATA  237,  66,  34, 249,  64,  42,  66,  64,  94,  35
280  DATA   86, 122, 179,  40, 176, 235, 175, 237,  66, 235
290  DATA   43, 115,  35, 114, 235,  24, 237,  82,  69,  77
300  DATA   79,  86,  69,  58,  45,  13,  49,  46,  32,  83
310  DATA   80,  65,  67,  69,  83,  13,  50,  46,  32,  82
320  DATA   69,  77,  83,  13,  51,  46,  32,  66,  79,  84
330  DATA   72,  13,  32,  32,  32,  32,  32,  63,  32,   0
```

Listing 2. A BASIC program which will load the machine code.

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Critical review?

"The sound commands on the Oric 1 are, for a computer of this price, very sophisticated. Three music channels, and one noise channel, mean that you can program some fairly complex sounds."

POPULAR COMPUTING WEEKLY

"Oric is everything you hoped it would be. Alive with colour, and zapping with built-in sound effects, the Oric looks like a match for any machine now selling for less than £200"

YOUR COMPUTER

"The 16k Oric – fighting the 16k Spectrum – is £25 cheaper. It feels a good deal more 'professional' than the home-appeal Sinclair. Oric's sound is extremely versatile, and well up to the standard of the £300 or £400 BBC microcomputer made by Acorn."

WHICH MICRO?

"Oric was over twice as fast as the Spectrum. Surprisingly perhaps the Oric, which initially seemed only faster when performing the simplest of calculations, has come back to beat the Spectrum by a small amount. As the problems get more complex the Oric comes into its own. One final point – in entering the benchmark tests – the Oric was certainly the easiest to handle."

WHICH MICRO?

"This slope coupled with the design of the keys makes the Oric an easy machine to touch-type on. All keys have auto-repeat and there are four keys dedicated specifically to cursor control. It is certainly easier to type on than any of Sinclair's offerings."

YOUR COMPUTER

"Oric will soon be selling a Modem so that Prestel will become available. Owners will be able to accept telesoftware – programs loaded straight down the phone line – eventually electronic mail could come into the home by the same route, and with the addition of a tape recorder the Oric with its Modem could become a telephone answerer and message taker."

YOUR COMPUTER

"One good feature of the Oric is an on-screen reminder in the top right hand corner to show that you've engaged all-capitals mode. So much better than the BB's variety of lights in the corner of the keyboard. The Oric is sound, simple to get along with and offers great expansion potential."

WHICH MICRO?

"When compared to the stogginess of the Spectrum's keyboard this is certainly an improvement. I can't see any Orics failing through bad assembly. If only the £2400 IBM were so easy to use."

WHICH MICRO?

"Instead of the Spectrum's 28 look-up single-character error reports, the Oric has 18 self-explanatory messages. If you actually want to do computing, rather than just exploring the world of off-the-shelf games programme entertainment the Oric will be a better buy."

WHICH MICRO?

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YOUR COMPUTER

"The modem is certainly unusual in a machine of this price. Together with the other peripherals, when finally available, it should make for an attractive package for a small business... surely a match for machines costing much more"

POPULAR COMPUTING WEEKLY

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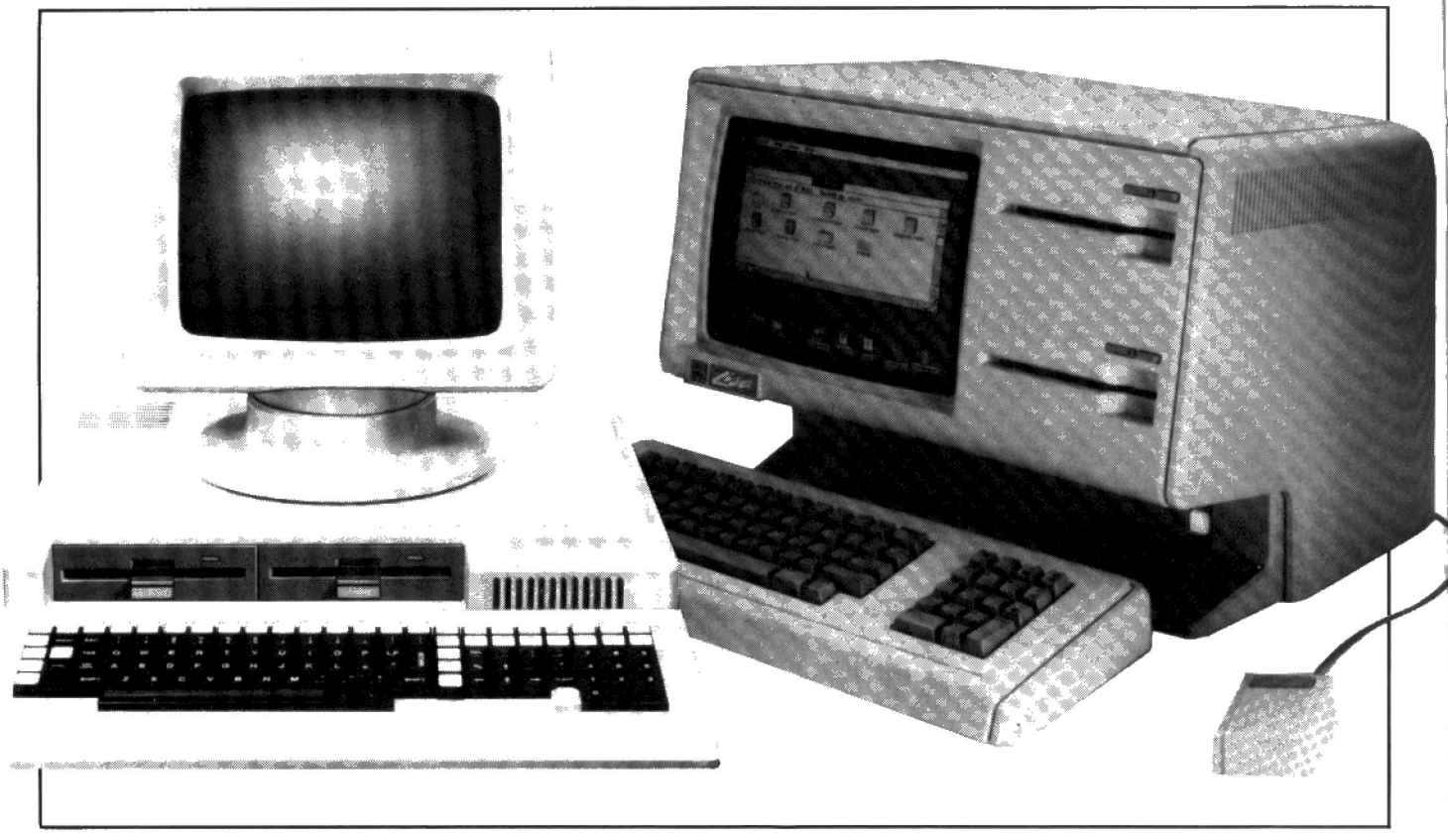
Bill Horne

SWEET SIXTEEN



Is the 16-bit micro really a worthwhile step-up from the more familiar eight-bit machines?

The microprocessor has grown and aged, appropriately enough, by multiples of two. First it could handle four bits, then eight, now 16, and soon — if all goes to plan — 32. The change from four bits to eight was an obvious necessity, though four-bit devices are still to be found in current production items. The eight-bit level held sway for a long time, but 16 bits are now seen as almost commonplace. Thirty-two bits are promised before long.

The advent of the first 16-bit processors brought much idle talk of a revolution in microcomputer techniques, but cynics remarked that some revolutions, when they are complete, bring everything back to the starting point. Will these new devices really take us off on an entirely new course, or will they prove to be little more than a passing fancy?

The question is important for the computing industry as a whole. Just when it was facing a need to shorten its defence lines and move towards consolidation, it is being tempted to diversify, to strike out into unfamiliar territory. Creation of software and hardware systems for the new processors is absorbing a great deal of time and money which might otherwise have been devoted to enhancement of existing systems. This involves something of a gamble, since it is difficult to be sure which of the new devices will survive the intense competition in which their manufacturers are currently engaged.

THE CONTENDERS

The Intel 8086 was first on the scene, and is now being joined by enhanced version, the 186 and 286. Next came the Zilog Z8000 family, regarded in some quarters as resembling the DEC PDP11 series. The Motorola 68000, on the other hand, has been compared with the DEC VAX concept, while the National 16032 aims at even higher levels. Still to come are various enhanced versions, and — eventually — the 32 bit models.

Anyone considering the creation of a new microcomputer thus has ample scope for choice of processor, and selection of one type or another is likely to prove crucial to success or failure in the long run. If the chosen device drops out of the race, or gets inadequate support, an expensive redesign could become necessary. That could be a catastrophe, so wise choice is essential.

All the manufacturers, of course, maintain that their products are completely viable in the long run, but it is difficult to see how they can all survive. There is already a hint of specialisation, with one type preferred for real-time on-line work, another showing suitability for number-crunching, and a third attracting the attention of business computer designers, but some types are regarded as being of less specific value.

A vital point is that success will breed success. If the software world decides to support a given processor type in particular, it will go a long way towards ensuring that the chosen component will

survive, since availability of support software may prove to be a major weapon in the struggle to beat the rest. However, the weapon will only be effective if the device itself is technically sound and well supported in other respects.

WHY SIXTEEN?

The vital question is why the 16-bit devices should be considered at all. Just what advantages do they offer in relation to the familiar well-established eight-bit devices?

The most obvious difference is that the 16-bit devices implement multiply and divide instructions, which reduce execution time for these functions to a tenth of that required with software implementations. However, it must be remembered that such instructions could well be incorporated in eight-bit devices, and an example is expected to appear on the market before the end of the year. Meanwhile, these instructions account for a large proportion of the speed advantage which is claimed for the new processors.

The ability to handle twice as many bits in a single transfer to or from store is a slightly dubious asset. If text is being handled, it may not be an asset at all, since the data will be in ASCII form, requiring only seven or eight bits per character. Financial calculations may be performed on an integer basis, with binary-coded-decimal data, or in floating point. Expansion to 16 bits is of little value for integer working, since a word will only allow calculations involving up to £655.36 in whole pence. BCD working, once favourite, is now less popular, but it works perfectly well with bytes.

Floating point is a different matter. With an eight-bit device, a single-precision floating point number involves four transfers. With a 16-bit device only two transfers are needed, but it may still be necessary to separate the exponent byte from the three mantissa bytes, which can be made part of the transfer process in eight-bit systems. Nevertheless, 16-bit working may confer a limited benefit in this area.

For real-time systems working with 'real' data, the 16-bit format offers clearer advantages, since integer working offers a sufficient degree of resolution, though some scaling of results may be needed to make the best use of the available word length.

Beyond all that, however, is the question of actual speed advantage. An eight-bit device working at 4MHz can transfer a 16-bit word to or from store in 5uS. A 16-bit device working at the same clock speed can halve that time if the address is available in explicit form, but the advantage is much less if the address mode calls for much calculation. If the required data has been carelessly allowed to sit on an odd address boundary, the 16-bit device has to make two store accesses, and will probably be slower than the eight-bit device.

So in general terms, the major source of speed advantage lies in the provision of multiply and divide, together with the separate question of clock speed, which will be looked at later.

ADDRESS RANGE

Challenged on the basis of significant speed advantage, the manufacturers proudly point out that their devices can address enormous amounts of store, up to 16,777,216 bytes in some cases. For those who consider 65,536 bytes unduly limiting, any extension at all is welcome, but it can be achieved quite effectively with an eight-bit processor by use of paging. Some of the 16-bit processors achieve their greater coverage by methods that amount to an enhanced paging system built into the processor chip.

The 8086 family use segment indices, 16-bit words which are multiplied by 16 to form base addresses for segment areas. Effective addresses are formed by adding the 'address within segment' to this base. This allows up to 65,536 segments to be identified, giving a coverage of 1,048,576 byte locations. Each segment can contain up to 65,536 locations, and can be established on any base address which is a multiple of 16.

To achieve this with an eight-bit processor would require an external segment store (perhaps two, to offer a quick switch between two areas) and a 16-bit adder to combine segment and displacement. Less convenient than the built-in arrangement, but requiring no radical software changes, this technique has been used with success.

One penalty of enhanced paging or segmentation is that the store areas, and particularly stack and work areas, have to be allocated with extreme care to avoid the possibility of overlap. For the Z8001, a separate Memory Management Unit performs this task, and also polices the boundaries to make sure there are no infringments.

The 68000 disdains paging and segmentation, setting up explicit 24-bit addresses in its 32-bit registers and putting them out directly. This means a lot of extra pins to connect the processor with its surroundings, but it does simplify address formation, and allows limit checking to be done within the processor.

As with simple paging, all these address handling methods entail some delays while the necessary calculations are performed. The instruction formats have to be a little more complex, so that code occupies rather more store, and allowance must be made for this. Which brings us back to another aspect of processing speed.

CLOCK RATES

With possible clock speeds ranging from 4MHz to over 10MHz, the 16-bit devices appear to inhabit a working speed range that starts where the eight-bit range leaves off, but that is not quite the complete story. As clock speed rises, the demands placed on store response time become more stringent, and the need for wait states has to be considered.

The vital response time is that measured at the processor pins, and it includes delays in address buffering and decoding, actual store response, and the time taken to return the data to the processor. Without going into detail, and bearing in mind the extra decoding needed with large stores, it can be said that overall response times of 300 — 350nS may be expected, perhaps rather more if particular forms of store are used.

At 350nS, a wait state becomes necessary for clock rates over about 7MHz. This will add one clock period (140nS) to the execution time for each store transfer performed. Clock rates up to 10MHz can be used with one wait state, and the faster execution of internal processor functions may produce higher speed than 7MHz with no wait state.

It would clearly be rash to assume that execution speed was proportional to clock speed, but there may be other relevant factors hidden in the 'small print'.

PREFETCH

In an effort to maximise speed, most of the new devices use a technique called 'prefetch'. Part or all of each instruction is read into a buffer before it is required, so ▶

that, ideally, the time required to fetch an instruction is minimised. The Z8000 series read the first word of the next instruction while the previous instruction is being executed. That is a safe procedure, though it means that the fetch time for any further words has to be included in execution time.

The 8086 has a queue buffer which can contain up to six pre-fetched instruction bytes. The buffer is refilled whenever it contains less than five bytes and the processor is not accessing store. On this basis, the stated execution times for instructions make no allowance for fetch time, it being assumed that the buffer always contains the instruction needed. Unfortunately, the buffer can run out of data, because some instructions remove more bytes than can be replaced during execution. The processor then has to wait while the buffer is replenished. Intel state that the actual execution time for a routine can be 10-15% longer than the sum of the individual instruction execution times, due to this effect.

Where wait states have to be used, the penalty can be higher, because refilling the buffer takes longer. For the enhanced forms of the 8086, the 186 and 286, instruction execution times have been shortened by improving microprograms and added facilities, so there is less time available to refill the buffer.

The overall result is that actual instruction speed can only be determined by timing a routine, though a rough estimate can be worked out rather laboriously by hand.

BENCHMARKS

There are those who swear by benchmarking, and those who simply swear whenever the term is mentioned, but it would be difficult to devise any alternative way of assessing processing capability. A classic example concerns a set of benchmarks issued by company A to prove that their device was the fastest in its class. Company B then re-issued the benchmark with the programs optimised for the competing processors, and that showed company A's product as slowest of all — and it is, in fact, even slower than the revised benchmark suggested.

The best way to use bench marks is to work out the reasons for the differences in speed. For example, the Z8000 family have ample register space for free use, and this allows the programmer to set up the parameters needed within a loop, so that the loop can execute at maximum speed. The 8086, which is in some ways an enlarged version of the 8080, dedicates most of its registers for particular duties, so the parameters have to be picked up from store within the loop. Eliminate loops, and the 8086 can compete. Where loops are needed, it lags behind.

SURVIVORS

That quick tour round some of the 16-bit devices will have shown that some of the 16-bit devices are not able to show a clear-cut advantage over their eight-bit ancestors in all respects. A number of other points could have been made, such as the claim that one of the most recent processors is no less than nine times as fast as the slowest, on the basis of the benchmark mentioned above. Nothing has been said about the Texas 99000, because it is really in a different class, using store locations as registers, and therefore highly dependent on the use of fast store elements.

So which will survive? With a crystal ball that is persistently cloudy, all that can be done here is to offer some cautious pointers.

Survival will undoubtedly depend to some extent on effective sales effort. It is sad that this is sometimes interpreted as an ability to slander the opposition, rather than provide all the necessary information regarding the product being presented. Such regrettable methods usually indicate that a concealed weakness is being protected, but the slanders can sometimes influence the potential customer's management, who have no understanding of the technical side of the matter.

Nevertheless, effective sales effort must include the provision of adequate information, and some salesmen clearly have little knowledge of the product they are offering. The fault here may lie in a lack of information supplied by the parent company, but in other cases it lies directly with the salesman himself.

Next, there is the question of the manufacturer's policy, stated or implied. The 8086 has been succeeded by enhanced versions, the 186 and 286. These are upward compatible, in that they will run 8086 code, though they have extra instructions of their own. How long can the 8086 survive in those circumstances? Perhaps it will survive longer than might be expected, because of the strong support which was given to it when it was the only pebble on the beach.

The Z8000 series, with their 32-bit successors in code compatible form to come, have not done too well in the microcomputer field — as yet — but are gaining ground in other areas of activity. The 86000 has appealed to those who waited long enough before making a decision. The fortunes of these two have been closely linked with ZENIX and UNIX, indicating the importance of available software backup.

The 16032 has been rather a Johnny-come-lately: It has attractive features, but those who are still busy assessing earlier offerings are reluctant to extend their studies for the moment, particularly as the documentation offered is still rather disjointed. Nevertheless, it could still be a dark horse to watch.

CONCLUSION

As a purely personal conclusion, it looks as if the 16-bit microprocessors will remain with us, despite their case for survival being rather weak in places. They will play no significant part in the field where machines are designed down to a given cost level, since their use almost inevitably implies relatively high cost. It would be interesting, as at least an academic exercise, to sketch out a 'fast BASIC' machine based on, say, the Z8001 with the forthcoming co-processor to do the floating point work. It would not be cheap, but it might upset a lot of preconceived ideas . . .

The real crunch will come when the 32-bit machines appear — and that will not be too far into the future. Meanwhile, all those bright entrepreneurs who are visualising the production of a 16-bit microprocessor that will sell because it uses the latest technology should think again. Not all the low-cost computers are merely toys, and when the dust kicked up by the latest flock of newcomers has died down there may be a new outlook for the computer market.

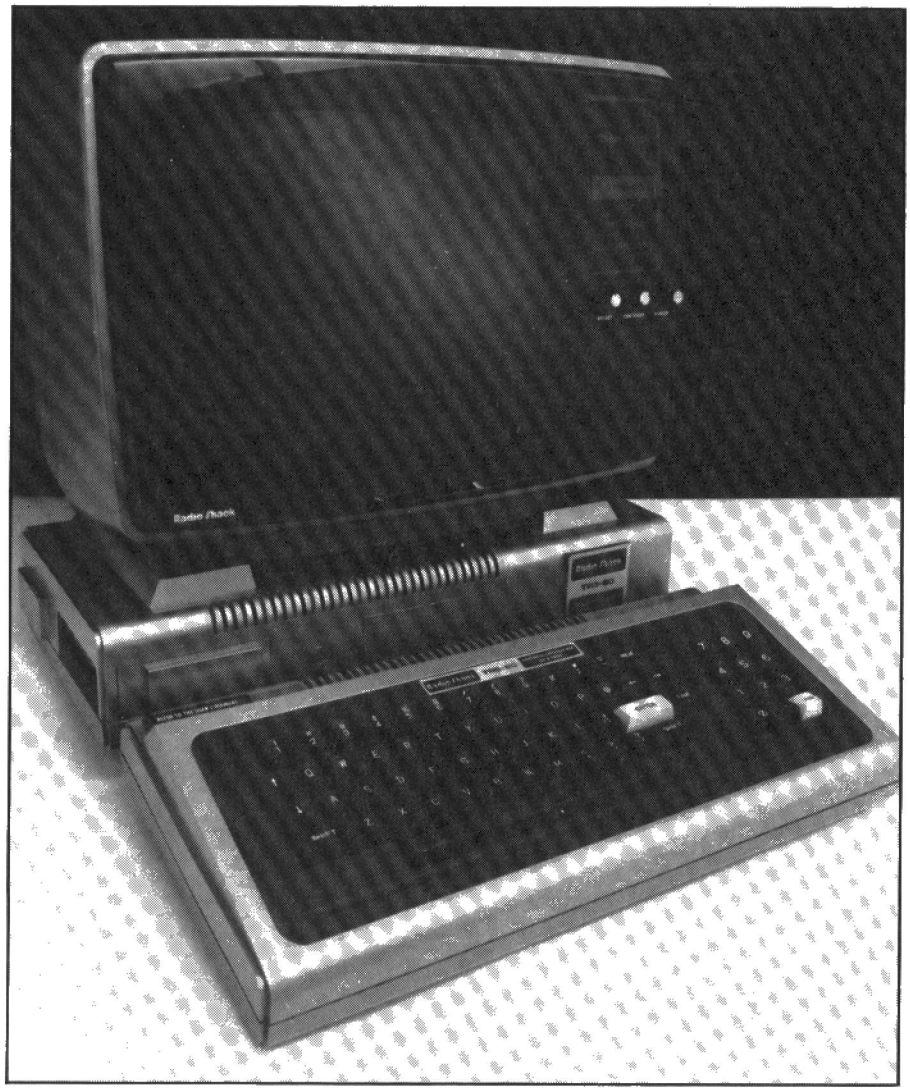
As was said earlier, the computer industry needs to shorten its lines and consolidate. For the moment, it is allowing its policies to be dictated by first-time users, amateur system enthusiasts and crafty salesmen. Here and there, a genuine hint of gold shines through, and more and more people are recognising the value of the true metal. The writing is on the wall, for those who can spare the time to read it . . .

See our 16-bit survey on page 63.

E J Oland

BOMB PROOF TANDY

Protect your programs from keyboard bashers with this simple crashproofing routine.



Imagine writing a game which contained a screen full of nice graphics and requiring a standard input on the top line, say something like noughts and crosses. Okay, you all say, no problem, but once written let a youngster or someone unfamiliar with computers play it and you might hear them saying, 'Hey the screen's gone blank', or 'Why have all the letters gone double size', or 'What's REDO mean?' These are three out of seven things which can corrupt a display by using a standard input, because unfortunately the TRS-80 will accept certain control codes via the input without pressing Enter. These are as follows:

Shift Right Arrow = Double Size Characters
Down Arrow = Line Feed
Right Arrow = Tab
Clear = Clear Screen

Pressing any of these will have an immediate effect on the display but the computer will still be waiting for you to press Enter to terminate the input.

Okay, so no one has pressed any of these keys, all we've got to contend with now is that the amount of characters typed in could be so great — up to 255 — that they erase part of the display. Pressing Enter will cause an automatic Line Feed with the same effect or a type mismatch resulting in a Line Feed and 'Redo' displayed which puts the input on the wrong line.

Try this standard input and press any of the control keys and see what happens to the white line.

```
10  CLS
20  FOR X=1 TO 127:SET (X,4):NEXT
30  ? @ 0, "Type in what you like";:INPUT A
```

Having suffered all these symptoms at some time I decided it was time to use INKEY$ to its full potential and not just for one character inputs which seems to be the norm. The program that follows might bring out cries of "I've been doing that for a long time", but for anyone just starting to use a TRS-80, I feel that they will find it very useful.

The one major downfall in using it is a certain amount of keyboard roll-over is lost, so if you can type very fast it is possible to beat the keyboard scan of the INKEY$, (removing all REMs will help).

CHARACTER CHECKING

The program is written as a subroutine and will keep check on the amount of characters being inputted as they are typed, so the criteria is to set variable AC to the total amount of characters you wish to input prior to calling the routine, this allows you to continually change the amount for different inputs. It is not wise to allow so many characters as to allow the cursor to drop to the next line as this will affect the back spacing and erase the whole line. IN$ is used for INKEY$ and will pick up all control codes and valid characters and then place them as ASCII in variable IN for checking, then if they are valid characters they will be displayed, the only control codes displayed will be backspace and delete whole line as these will not corrupt the display. Pressing Enter will cause a RETURN from the routine, with TP$ containing only valid characters and not control codes and variable VA will contain the value of TP$ if any.
So, if your input would be INPUT A$ or INPUT N you would now use:

```
'AC=6:GOSUB 1000:A$=TP$
'AC=6:GOSUB 1000:N=VA
```

Obviously the 'AC = 6' would be set to your own needs.

The program as it stands is only set to respond to control codes$ 13 (Enter) at Line 1300, code 8 (Back Space) at Line 1190 and Code 24 (Delete Line) at Line 1240, but can easily be adapted to respond to any or all of the control codes.

It is laid out without too many multi-statement lines purely for readability, but by using multi-statement lines and the 'ELSE' statement it can be greatly condensed.

The advantages of using this routine are that the length of the input is not able to exceed the amount you wish, only the non-destructive characters and codes will be displayed, you can have a flashing cursor and you get a visual display of dots representing the amount of characters to be inputted, but best of all, used with the PRINT @ statement, it won't destroy your display.

If you are worried about the Break key fouling things up and you are not using discs, try POKE 16396, 175 but beware if you are using an expansion box because the only way to stop the program after using this POKE is by pressing Reset and you'll lose the program, but only if you have got the expansion box switched on.

```
   1  REM ** TRS-80 LEVEL II: BOMB PROOF INPUT
   2  REM ** AC=THE TOTAL AMOUNT OF CHARACTERS
   3  REM ** CC=CHARACTER COUNT, CHECKED AGAINST AC
   4  REM ** IN=ASCII VALUE OF INPUTTED CHARACTER
   5  REM ** VA=NUMERAL VALUE OF TOTAL OF INPUTTED CHARACTERS
   6  REM ** IN$=SINGLE CHARACTER INPUTTED VIA INKEY$
   7  REM ** TP$=FINAL STRING OF CHARACTERS INPUTTED
  20  CLEAR 2000
  30  CLS
  40  FOR X=1 TO 127:SET (X,4):NEXT
 100  PRINT@0,CHR$(30);"TYPE IN WHAT YOU LIKE. ";
 120  AC=40:REM ** SET TOTAL OF CHARACTERS ALLOWED.
 130  REM ** INPUT <=AC, NEVER >AC. ENTER NOT COUNTED
 140  GOSUB 1000:REM ** GO AND WAIT FOR KEYSCAN.
 160  PRINT@128,CHR$(31);"THIS IS WHAT YOU LAST TYPED AND
      IT DIDN'T DESTROY THE LINE."
 170  PRINT " VA =";VA:PRINT "TP$ = ";TP$;
 180  GOTO 100
 980  REM ** KEYBOARD SCAN ROUTINE
 985  REM ** ON ENTRY
 990  REM ** SET AC TO LIMIT AMOUNT OF CHARACTERS INPUT
1000  CC=0:TP$="":VA=0:REM ** ZERO VARIABLES
1010  REM ** PRINT A STRING OF DOTS TO SHOW THE USER
1020  REM ** HOW MANY CHARACTERS ARE ALLOWED
1030  PRINT STRING$(AC,136);
1040  REM ** MOVE CURSOR BACK AC CHARACTERS READY TO
      TYPE OVER THE DOTS
1050  PRINT STRING$(AC,24);
1060  CC=CC+1
1070  PRINT CHR$(14);:REM ** TURN CURSOR ON
1080  REM ** KEEP CURSOR ON FOR X PERIOD
1090  FOR X=1 TO 20
1100  IN$=INKEY$:IF IN$<>"" THEN 1180
1110  NEXT X
1120  PRINT CHR$(15);:TURN CURSOR OFF
1130  REM ** KEEP CURSOR OFF FOR X PERIOD
1140  FOR X=1 TO 20
1150  IN$=INKEY$:IF IN$<>"" THEN 1180
1160  NEXT X
1170  GOTO 1070
1180  IN=ASC(IN$):REM ** GET ASCII
1190  IF IN<8 OR LEN(TP$)<1 THEN 1240:REM ** CHECK FOR B/S
1200  TP$=LEFT$(TP$,LEN(TP$)-1):CC=CC-1:PRINT IN$;
1210  PRINT CHR$(136);:REM ** PUT DOT BACK ON SCREEN
1220  PRINT CHR$(24);:REM ** MOVE CURSOR BACK 1
1230  GOTO 1070
1240  IF IN<>24 THEN 1300:REM ** CHECK FOR LINE DELETE
1250  PRINT CHR$(15);:REM ** TURN CURSOR OFF TO STOP FLASH
1260  PRINT STRING$(LEN(TP$),8);:CC=1:TP$="":REM ** ERASE LINE
1270  PRINT STRING$(AC,136);:REM ** PUT DOTS BACK ON SCREEN
1280  PRINT STRING$(AC,24);:REM ** MOVE CURSOR BACK
1290  GOTO 1070
1300  IF IN<>13 THEN 1340:REM ** CHECK FOR ENTER
1310  VA=VAL(TP$):REM ** GET VALUE AND PUT IN VA.
      BEWARE OF OVERFLOW AND ROUNDING ERRORS
1320  PRINT CHR$(15);
1330  RETURN
1340  IF IN<32 THEN 1070:REM ** CHECK FOR VALID CHARACTER
1350  IF CC>AC THEN 1070:REM ** CHECK FOR EXCESSIVE INPUT
1360  TP$=TP$+IN$:REM ** CONCATENATE STRING
1370  PRINT IN$;REM ** PRINT INKEY STRING AT CURSOR POSITION
1380  GOTO 1060
```

Listing 1. The program to prevent your Tandy from crashing.

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In addition to the disc pack a second processor is supplied. This is a Z-80A with its own 64K RAM card, communicating with the 6502A in the BBC computer through the 'Tube'. Typically the speed of execution of programs under the twin-processor system is increased by up to 50% compared with a conventional single-processor computer. A third processor, the 16 bit 68000, will shortly be available.

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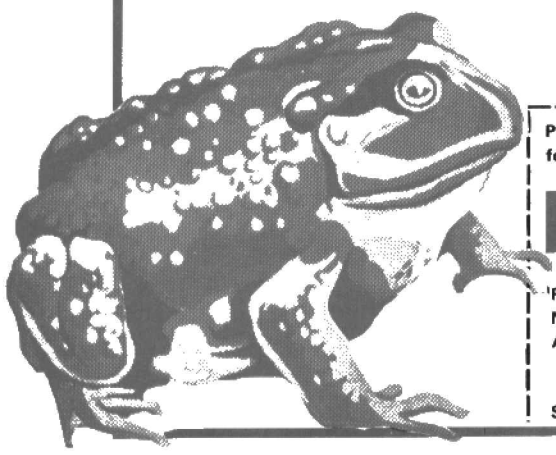
The program follows the style of that arcade favourite, Frogger and you must negotiate your green coloured friend across first a road populated with fast moving cars and lorries and then over the river by means of turtles and logs. Frogs may be able to swim but if your turtle decides to sink you'll be swept away by the current. Once across with three out of your four frogs you'll be able to score bonus points by catching the flies that appear over the river but, take care that you don't run out of time!

All in all it's a great, fast moving game that any number of people can play and, just to add to the spirit of the thing the program stores the top ten players' names so you can measure your performance. How much are we charging for this minor masterpiece? Just £5.99 all inclusive!



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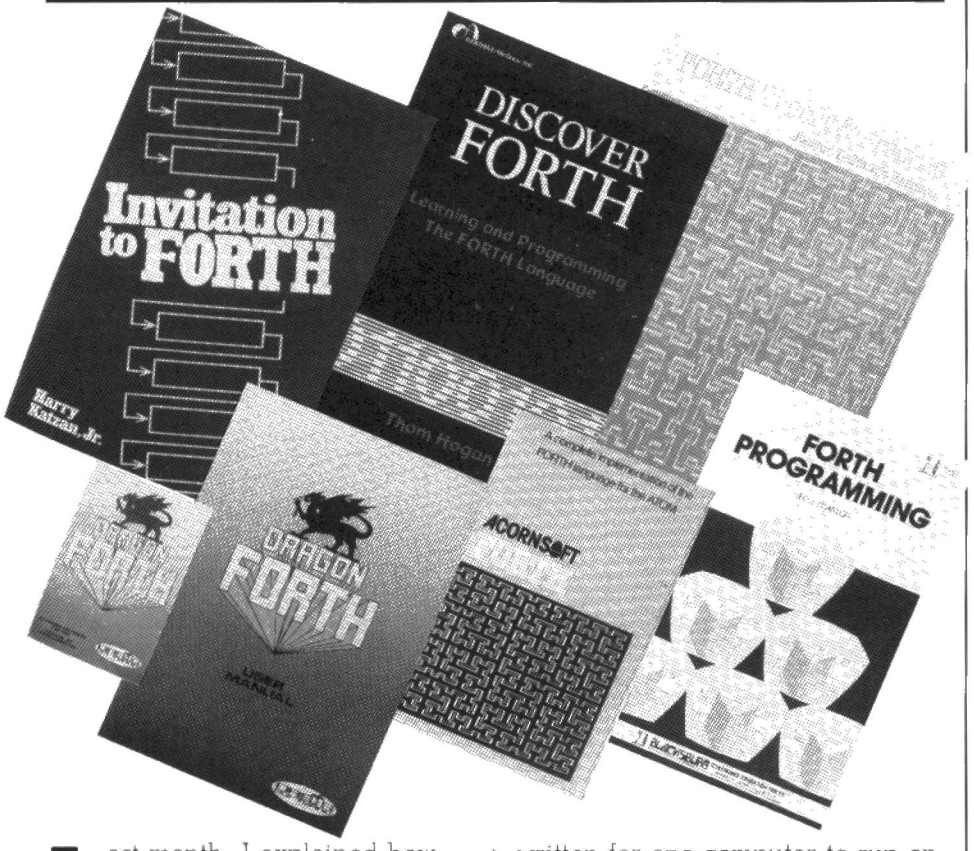
CT July '83

D S Peckett

GOING FORTH AGAIN

In the final part of this article about FORTH we look at the two main versions and also review what is available in FORTH for the more popular micros in the UK.



Last month, I explained how FORTH could be extended to include non-standard features such as arrays and error-checking. During those explanations, I referred several times to the existence of two standard versions of the language. It is now time to go into more detail on these two standards and try to see why they exist and what their differences are. Having done that, I will take a look at the UK FORTH market in an attempt to identify what versions of the language are available for the more common computers. I will also review very briefly some of these implementations.

FORTH STANDARDS

First of all, though, why should we have 'standards' for FORTH, or for any other language? Anyone who has tried to get a BASIC program written for one computer to run on another should be able to answer that question with no trouble at all. Software is the key to any effective use of computers and, to get the best value out of any program, it should be compatible with as many computers as possible.

In practice, though, life is not that easy, particularly where micros, rather than minis or mainframes, are concerned. It is understandable that different machines should have different hardware features, which in turn need special-to-type language features; for instance, the BBC computer's graphics are so much more powerful than those of the TRS-80 that it would be ludicrous to attempt to control them with the same commands.

What is less understandable is that different micros use different commands to do the same fundamental things or, even worse, use the same command to do different things. Compare, for example, the approaches taken by Microsoft and ZX BASICs to string truncation. It is sometimes hard to avoid the conclusion that the differences are only there for commercial factors, such as 'Not Invented Here', or the desire to 'lock-in' a customer to one particular computer family.

Whatever the reason, the variations make life very complicated for the programmer who has to handle more than one computer type. Life is a little easier if he deals with only Microsoft BASIC, since that is so widely used that it is effectively a standard.

Most other computer languages are very rigorously defined, so that it is relatively easy to take, say, a COBOL program written for one system and run it on another. Some of the hardware-dependent bells and whistles may be lacking but the main program should be OK.

With its anarchic ability to re-define itself, FORTH seems, at first sight, a curious language to attract any sort of standard. However, with the aim of making it easier to move FORTH programs between computers, not one, but two, standards have come into being, although only one is really strict enough to be called a 'standard'. The latter, sponsored by the FORTH Standards Team, is called FORTH-79, while the other, prepared by the FORTH Interest Group, is known as fig-FORTH.

FORTH-79

FORTH-79 defines a fundamental core of the language whose purpose "...is to allow transportability of standard FORTH programs in source form along standard FORTH systems. A standard program shall execute equivalently on all standard FORTH systems...". That mouthful, taken from the language specification, means that any -79 program should run on any system which claims to be to FORTH-79 standard.

The standard provides a list of useful FORTH words, broken down into four categories:

a. Nucleus Words. The fundamental arithmetic, memory manipulation and stack handling words you need to write a program, or to do anything useful. Typical examples are: [*], [>R], [@], DROP, IF, NOT, ROT and [UK].

b. Interpreter Words. The words ▶

needed to interact with the FORTH system, drive the keyboard and display and to format the output. Good examples are: [(], BASE, CR, DECIMAL and PAD.

c. Compiler Words. Certain words are only used when compiling new words and manipulating the system dictionary. They are the key to the FORTH concept of expandability and include: [:...;], ALLOT, DOES>, REPEAT and VOCABULARY.

d. Device Words. Finally, FORTH-79 provides a few words to manipulate the system's bulk storage, such as: BUFFER, LOAD and UPDATE.

The specification defines carefully what each word must do, and what its stack action is, but makes no stipulation about how the language should be put on the computer. For a standard, this is perfectly reasonable since, if a language behaves as it should, it does not really matter how it got there in the first place (and yes, I know that is a simplification). A notable absence from the 'Required Word Set' of FORTH-79 is any form of editor. Again, this is not unreasonable, since the way in which source code is actually prepared should not affect FORTH's run-time behaviour.

In theory a FORTH-79 program written on computer 'A' can be re-entered in computer 'B', which also has -79, and will run perfectly. And so it will, unless the original program did anything machine-dependent, like using the standard words to create new words that wrote directly to display memory. It's hard to see any real way around this problem, however, but if FORTH-79 is used to create only non-machine-dependent words, then the aim of transportable programs should be achieved.

Because FORTH-79 is a formal, rigorously-defined, language with a professional attitude to its requirements, it tends to be used on the larger microcomputer systems. Most CP/M implementations of FORTH use it, although it is now also starting to appear in the cheaper, 'hobby', packages. Most versions of -79 contain many more than the 130 or so words in the standard; the extra words provide the editor, exploit particular features (such as graphics) of the host computer, give double-precision and/or floating point arithmetic and generally make the whole thing easier to use. The FORTH-79 standard does not prevent this — as long as all its required words are present, it is happy, and transportable programs can be written with just those.

FIG-FORTH

Fig-FORTH takes a very different approach from -79 and, in fact, is not a true standard. It grew out of a wish by the (American) FORTH Interest Group to publicise the language and "...to make this valuable tool available on a personal computing level...". The fig-FORTH manual is, therefore, a do-it-yourself FORTH kit, enabling an experienced programmer to put the language up on virtually any computer.

The manual defines about 240 words but, since it is not a true specification, makes no stipulation about how many of them must be present. A full system, prepared from the manual, will contain most of the words in the FORTH-79 standard, or their equivalents, in order to produce the user part of the language.

However, on top of those, a fig-FORTH system will contain a group of editing words and a large number of 'system' words. The latter, while they rarely appear in programs, are essential to the system's housekeeping and fall into four main groups:

a. Constants used to set up specific aspects of the system, such as the size of each screen.

b. System variables, such as USE, which contains the address of the next block buffer to be used.

c. Run-time procedures, such as [(DO)], used by other FORTH words (in this case, by [DO]).

d. Various utility words needed to make the system work, such as DR0 which selects disc drive zero.

Any FORTH-79 system will have their equivalents, but they are not specified in the standard since they do not form part of the language itself.

Because of the 'DIY' nature of fig, most of the smaller FORTH systems around use this version of the language — quite simply, it's quicker and easier to write than -79. However, since the fig-FORTH 'specification' does not demand a minimum set of words, there is no guarantee that programs can be transferred easily from computer to computer. All the common words are likely to be available, but some of the more obscure ones will be missing; even worse, some words could have different effects in different systems.

Like FORTH-79, fig makes no attempt to handle machine-dependent systems. It does, however, go into a fair amount of detail as to how bulk storage shold be handled. Like any compiled language, FORTH needs a backing store, and disc are much quicker and easier to use than tape.

In an attempt to improve tape-based bulk storage, fig-FORTH introduces the concept of a disc simulation in RAM. Screens may be held in RAM and edited as if they were on disc; when correct they can be dumped to tape. The approach does, of course, assume that sufficient RAM is available in the system but, with FORTH's compactness, this is often easy to arrange. In comparison, -79 calls for 'mass storage block buffers' and leaves it at that.

FORTH-79 AND FIG-FORTH

In practical terms, there is very little difference between FORTH-79 and fig-FORTH. However, there are a few significant discrepancies, which are detailed below. The following words with different names act identically:

-79	fig
>IN	IN
?DUP	-DUP
CONVERT	(NUMBER)
DNEGATE	DMINUS
EXIT	;S
NEGATE	MINUS
R@	R
U/MOD	U/

Three words perform similar actions in the two versions but make different use of the stack: SIGN, VARIABLE and WORD.

Finally, fig's <BUILDS... DOES> and -79's CREATE... DOES> produce rather different dictionary entries, although their basic effect is the same.

When it comes to overcoming these differences, however, FORTH's extensibility proves its worth. In most cases, it is easy to set up a -79 system to behave like fig, and ***vice-versa***. For example:

```
: U/MOD  U/ ;
```

will add a FORTH-79 word to a fig-FORTH system.

Be careful, though, because the emulation is not always exact. The best example is FORTH-79's [CREATE...DOES>... and fig-FORTH's [<BUILDS...DOES> ...]. If you are just dealing with words, the two constructions are equivalent but they actually work very differently at the system and dictionary levels. Any program which relies on probing deeply into the dictionary entries could go sadly astray if moved between fig and -79 systems.

AVAILABLE FORTH SYSTEMS

For the rest of this article I will survey the UK FORTH market at the time of writing (late Jan '83). Concentrating mainly on the smaller computers, I will give very brief details of the versions of the language which are available and, in some cases, highlight some of their more interesting features. The list is, inevitably, incomplete and nothing sinister should be read into the choice of versions which I describe in more detail; it simply reflects the data that suppliers were willing to give me. The details are arranged by computer types.

Acorn ATOM. Acornsoft, of 4a Market Hill, Cambridge CB2 3NJ, supply a fairly standard implementation of fig-FORTH for the ATOM; it costs £11.50 and the full manual is another £6.50. Its most obvious restriction is that it only has a single tape buffer, which could make writing programs a little cumbersome but, otherwise, it appears to be a very nice version of the language. It has a graphics extension to exploit the computer's display and the manual, although apparently a little pricy, is first class and acts as an excellent FORTH primer. I must add, however, that I thought it a pity that the manual's Glossary did not list the Editor and Graphics words — these are specified elsewhere in the book.

For more information on ATOM FORTH, see the review in the Oct '82 issue of *Computing Today*.

Apple II. Among the many implementations of the language for the Apple, two disc versions are particularly well-established:
a. Apple FORTH, costing around £70 and distributed by Apple (UK) Ltd., this is the 'standard' FORTH available from your friendly Apple dealer.
b. GraFORTH, costing £57.50 and distributed by Apple Orchard, 17 Wigmore Street, London W1, is a specialised version of the language for graphics applications. It is relatively slow in operation and uses non-standard syntax.

Atari 800. The principal, if not only, FORTH for the Atari is 'QSFORTH', available from the main distributors, Maplin Electronic Supplies Ltd, PO Box 3, Rayleigh, Essex. It is a disc-based fig- system costing around £50 and appears to be a very attractive version of the language.

The standard package contains 453 words, including all those in the 6502-based version of fig-FORTH. In addition to these 'standard' words, QSFORTH also includes extension to provide a 6502 assembler, I/O file handling and a powerful screen editor. In addition, it also contains words to exploit the Atari's outstanding graphics and sound facilities and, on paper, seems to be a most impressive system.

BBC Micro. At the time of writing, there appear to be three different FORTHs available for the Beeb.

Acornsoft (address above) supply, although there have been the usual regrettable production delays, a tape-based FORTH-79 system for 32K computers. The cost is £16.50 but, as with the ATOM, this may not include the manual.

HCCS Associates, 533 Durham Road, Low Fell, Gateshead, Tyne & Wear, NE9 5EY, supply a FORTH in ROM for £34.72. Although ROMed languages are particularly attractive for the BBC Micro, you should remember that they will not work with OS 0.10.

Finally, Level 9 Computing, 229 Hughenden Road, High Wycombe, Bucks, supply the tape-based 'rqFORTH' for £15. This implementation is an interesting hybrid of FORTH-79 and fig-FORTH in that the suppliers have used the fig manual to generate what appears to be a true -79 system. In doing so, they have also incorporated most of the features of fig. The system will run in 16K computer, which makes it doubly attractive, but in this case it is normally restricted to Mode 7.

rqFORTH is fast and has a first-class screen editor, although the Mode 7 display means 512-byte screens rather than the more usual 1024-byte system. RAM buffers provide a pseudo-disc system, although the 'virtual memory' system of some implementations is missing. The main limitation is a complete lack of commands to exploit the computer's graphics, sound, etc, should 32K of RAM be available; fortunately, the manual's clear description of the system memory-map and rqFORTH's ability to interact with the Beeb's operating system make it relatively easy to add the missing commands. You should also note that the manual does not pretend to be a FORTH primer, although it gives a lot of information about the system for its more experienced readers.

Overall, a good buy, but it would be interesting to compare it with Acorn's implementation.

Dragon 32. FORTH implementations for the Dragon 32 are available from:
a. Jade Computers, Coombend, Radstock, Bath, Avon, BA3 3GA (price £18.95).
b. Microtanic Computer Systems Ltd, 235, Freim Road, Dulwich, London SE22 (price £24.95).

NASCOM. The best-known version of the language for the Nascom series of computers is 'HullFORTH', from A F T Winfield, 148 Goddard Ave, Hull, HU5 2BP. This is an unusual implementation which does not compile to the 'indirect threaded code', driven by an inner interpreter, of most FORTHs; instead, it produces something quite close to native Z-80 code. Consequently, it should be unusually fast. Although it is a non-standard version, it is generally fig-like.

The system appears to be quite flexible, but its tape interface is a little clumsy. HullFORTH contains two 1024-byte tape buffers (which is useful), but the reading and writing of them is controlled manually — it lacks a virtual memory system.

The other limitation of the language is its restricted extensibility. Extra words may be added by the usual colon definition but there is nothing like the <BUILDS . . DOES> construction. Consequently, it is very difficult to add new compiling words to HullFORTH. This may or may not be a limitation, depending on your requirements.

PET. A PET-FORTH is available from dealers; beyond the fact that it is similar to the VIC-FORTH described later, I have no further details.

Sharp MZ-80 Series. A tape-based, possibly non-standard, FORTH is available for MZ-80K and 'A computers from Knight's Computers, 108 Rosemount Place, Aberdeen.

A second, very impressive, version of the language is supplied by Kuma Computers, 1 York Road, Maidenhead, Berks for the MZ-80K, 'A and 'B computers; all three versions are available on tape or disc.

Kuma FORTH, which costs around £40, is a comprehensive version of fig-FORTH with very useful extensions to handle floating point numbers (rare in FORTH) and to give BASIC-like string handling commands. Writing complex programs is made easy by no less than sixteen 1024-byte screen buffers in RAM which act as ▶

a sort of pseudo-disc; if you need even more memory, the buffers are backed up by a virtual memory system. Source code is written via a line-oriented editor and, in the MZ-80B and CP/M-based 'A and 'K systems, a much more powerful screen editor is also available.

The whole package is backed up by a comprehensive, but not particularly easy to follow, manual. All in all, it looks like a nice system, although a little pricy.

TRS-80/ Video Genie. Complete FORTH systems for the TRS-80 and its Genie clone are rare. The best-known is MMSFORTH, by Miller Microcomputer Services, Natick, Maryland, USA, which is supplied in the UK by Microcomputer Applications, 41 Queen's Road, Blandford Forum, Dorset DT11 7LA.

The current version of MMSFORTH is V2.0, which is a disc-based system to FORTH-79 standard with many extensions, such as graphics, string-handling, double-precision arithmetic and other goodies, and costs £100. Although expensive, this is undoubtedly one of the best FORTHs around and has many unique features.

VIC-20. You should be able to buy a copy of VIC-FORTH from your local dealer for £38.95. This is a cartridge-based version which comes in two flavours: tape backing store and disc backing store. Since it is ROM-based, the language kernel is always available; the cartridge also contains an additional 3K of RAM which, though it may not sound much, is quite a lot for FORTH and will let you write fairly complex programs.

The language is fig-based with a few alterations and additions. It provides a full set of double-precision words, which are always useful, and, for the experts, its DOES>acts like the -79 version, rather than fig. Because of the limitations of the VIC's display, the language uses non-standard 256-byte screens, which may prove a little restrictive. On the other hand, however, there are a number of I/O commands which should make it easy to use external files.

VIC-FORTH has no words to exploit the computer's graphics, although they could, no doubt, be added. A more serious omission, at least in some versions of VIC-FORTH, is that the virtually essential editor is not in the ROM. The manual provides a listing to add one to the language but I feel that it should be there all the time. The manual also has instructions for adding a 6502 assembler, which is useful for applications which need even more speed than FORTH offers, or which are very hardware oriented.

ZX81. The only FORTH for the ZX81 which I have found is that offered by Artic Computing, 396 James Reckett Ave, Hull HU8 0JA. It is normally supplied on tape for £35, although I believe that a ROM-based version is also coming. This is a pretty standard fig-FORTH implementation with few extensions.

It can, of course, display the ZX81's chunky graphics. Programs are written via a standard 1024-byte screen buffer which can be saved and read from tape by means of explicit instructions — there is no virtual memory system. The ZX FORTH manual is comprehensive, in that it describes all the language's facilities but, like the manuals with many systems, it is not a self-teaching manual for FORTH.

Jupiter Ace. I have left the Jupiter Ace to the end since, as the only freely-available computer which has FORTH as its native language, it is in a class of its own. The computer was fully described in last month's *Computing Today*, and so I will not go into great detail here.

In summary, the computer looks rather like a ZX80 and provides a very interesting and powerful dialect of fig-FORTH. The main differences from other implementations are its approach to<BUILDS...DOES>, using DEFINER...DOES>, which is better suited to the Ace's architecture and, most importantly, the lack of a normal FORTH editor.

In virtually every other version of the language, the 'screen' concept is built on the assumption that the system will be disc-based; tape-based systems emulate disc with varying degrees of success. The Ace has not attempted to use the screen approach — instead, words are defined directly into memory. To allow you to see an change the source code — the main job of screens — the Ace has a FORTH decompiler which allows any word in the language to be recovered, edited, and restored to memory. This is a very clever approach which neatly gets around the unavoidable problems of tape storage; furthermore, it should make the Ace much easier for the beginner to use, justifying its designers' hopes.

All in all, the Ace looks extremely nice on paper, although I am not quite so sure about its appearance 'in the plastic' and its ZX Spectrum-like keyboard. On the other hand, it is very cheap and should introduce a lot of people to FORTH.

CONCLUSION

In this article, I have described the two main varieties of FORTH that are available and attempted to explain why two 'standards' should exist. I then surveyed the lower end of the market for the language and found that there are a surprising number of implementations around. Virtually anyone with a computer who wants to try the language can now do so, and often for no more than the price of a good game.

In general, I am not over-impressed by many of the versions of the language. They tend to take the easy approach of fig-FORTH (and why not, it's cheaper) and, more seriously, often fail to exploit the host computer's hardware properly, particularly when it comes to graphcis. Editors and tape interfaces are not always as easy to use as they might be.

Finally, some of the manuals are disappointing. A few are very good and I did not find any appalling ones, but the majority are not suitable for beginners to the language. They contain all the essential information, but rely on the user's knowing what he is after. To be fair, some of the manuals state specifically that they are not learning guides and refer you to books such as the very good **Starting FORTH** by Leo Brodie.

The Jupiter Ace is somewhat different from all the other versions of the language, setting out to be a properly designed and integrated FORTH computer. As far as I can tell, it succeeds very well in its aim, and is backed up by good documentation.

ACKNOWLEDGMENTS

Finally, I would like to thank the many FORTH suppliers for their help in preparing this article. I am also particularly grateful to the FORTH Interest Group (UK) for its aid; FIG(UK) is a good source of FORTH information and ideas and may be contacted via:

Mr Keith Goldie-Morrison,
Honorary Secretary — FIG(UK),
15, St Albans Mansions,
Kensington Court Palace,
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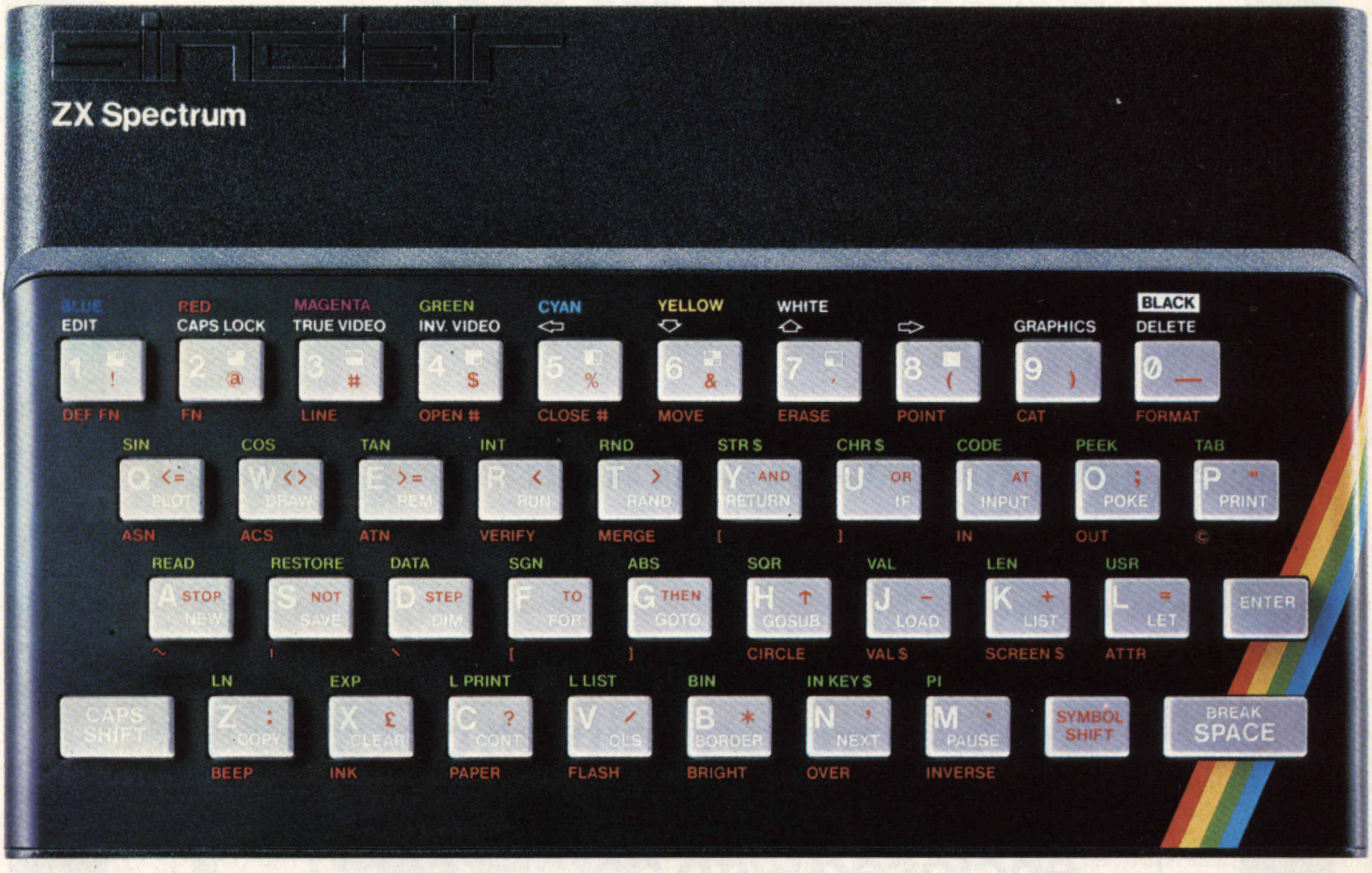

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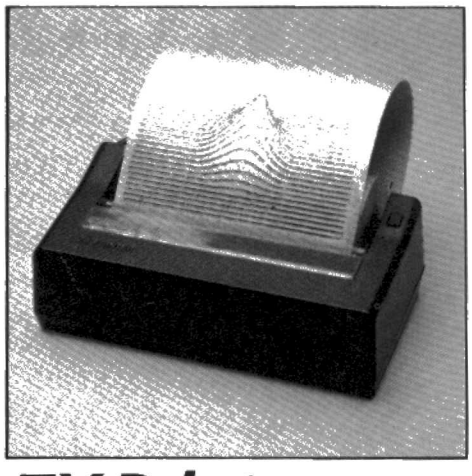

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Garry Marshall

LANGUAGES IN USE

Representing solid three dimensional objects on your micro may appear somewhat daunting, but read on and find out how it can be done, and in what language.

In many areas where computer graphics are applied it is useful, and even necessary, to be able to represent solid three-dimensional objects in a realistic way. The most sophisticated areas of application include the computer-generated displays in flight simulators, and the ergonomic design of the interiors of cars and aircraft cabins. These are high-technology applications financed by companies such as Redifon Simulation, Ford and Boeing with large research and development budgets. They utilise expensive hardware attached to mainframe computers, and many hours have been devoted to developing the necessary software.

Although the graphics capabilities of microcomputers do not permit programs of such sophistication as these to be developed and run as yet, they do permit the programming of graphics effects comparable with what could be achieved with mainframe computers in the not-too-distant past. Currently there is a program available from Thorn-EMI called 'Jumbo Jet Pilot' that gives a creditable imitation of a session in a flight simulator with its flight simulation graphics and instrument control panel.

DEALING WITH THREE DIMENSIONS

The applications of three-dimensional graphics on micros are naturally far less ambitious than their mainframe equivalents. Games figure prominently, but more serious applications can be found. These include an interactive program for designing the layout of a room or an office. This program allows furniture to be selected from a standard catalogue and positioned, and then displays the appearance of the furnished room from any of a number of viewpoints. This type of computer-aided design is typical of what can be achieved with a micro. It is far from a trivial application since it not only permits the user to visualise the appearance of the furnished room but can also allow him to test such easily overlooked matters as whether the doors will still open, whether the windows are blocked and whether there is room for a person to move around the items of furniture.

The main applications of three-dimensional graphics on micros are to help in the understanding of complex situations, which it does in a natural way since pictorial communication is ideal for people, to aid in the design process, and to enhance programs intended for amusement and enjoyment.

Realistic representation of solid three-dimensional objects on a flat two-dimensional surface is an ancient art dating back to the artists of the Renaissance who first managed to produce successful perspective drawings in the years around 1400. Their method of creating perspective drawings was essentially constructive, and involved establishing a horizon and a 'vanishing point' at which lines that were actually parallel met in their perspective representation. It might be argued that these constructions are of little value in computer graphics, but they do describe the essentials of producing perspective drawings. When the methods of three-dimensional geometry are applied to it, they give the formulae necessary to achieve perspective in computer graphics. The high resolutions now available with many microcomputer displays mean that with the aid of these formulae they can display realistic perspective drawings.

In this article, we first examine the perspective transformation and show how it can be used to program perspective views of a solid object. As we shall see, the images that result do have certain shortcomings, and we examine ways of overcoming them. The language in which these examples are programmed is BASIC incorporating representative graphics commands from microcomputer dialects of BASIC. There is, however, a special-purpose graphics language available for microcomputers called GINO-F. We will demonstrate that the creation of images of three-dimensional objects is much simpler using GINO-F than a typical microcomputer BASIC. In particular, no mathematical knowledge is necessary.

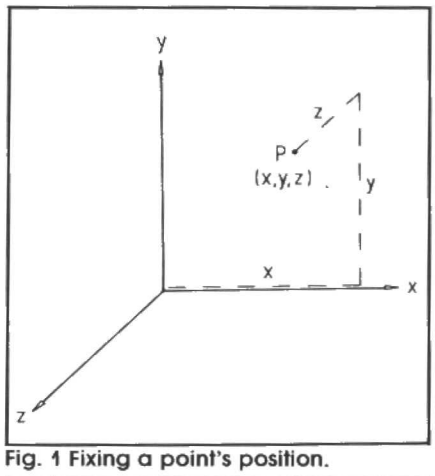

Fig. 1 Fixing a point's position.

PERSPECTIVE

The idea of perspective is to represent a three-dimensional object in a realistic way on a flat two-dimensional surface. This is to say that the object should be drawn in the same form as we see it.

The first essential, therefore, is to be able to fix the position of an object in three-dimensional space. The position of a point can be fixed using three-dimensional cartesian coordinates, so that its position is given with reference to three mutually perpendicular axes as shown in Fig. 1. The x- and y-axes are in the plane of the paper with the z-axis coming out of the page. The point at which the three axes meet is called the 'origin'. The position of a point P can be specified by giving the distances from the origin to a point level with P in the directions of each of the x-, y- and z-axes, as shown in Fig. 1. This position is written as (x, y, z) and the three values are referred to as the x-, y- and z-coordinates.

When we can describe the

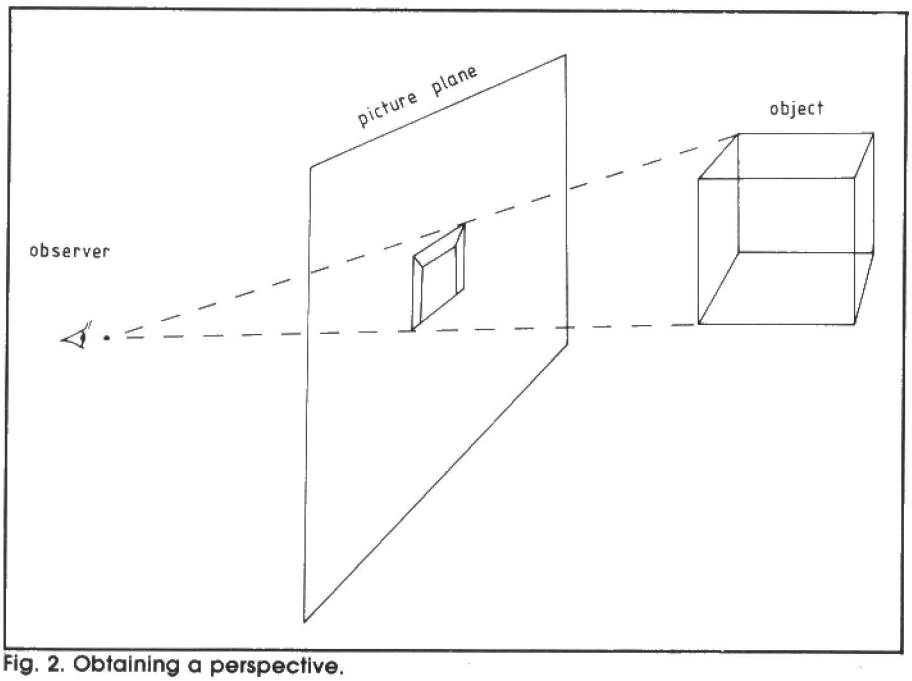

Fig. 2. Obtaining a perspective.

location of a point the location of a solid object can be described by giving the locations of the significant points on its surface. The edges of the object can be described by giving the lines that join these points. A cube, for example, can be specified by giving the points at its corners and then describing how these points need to be joined to give the edges of the cube.

The second thing that needs to be decided before an object can be drawn in perspective is the situation of the observer. This involves giving not only the position of the observer but also the direction in which he is looking. Clearly the object will appear smaller when viewed from further away while different views of it will be obtained from different angles. Also, if the viewer is looking away from the object he will not see it at all!

The third factor affecting the way in which the perspective view is obtained is the position of the plane surface on which the perspective view is to be produced. This plane is known as the 'picture plane'. The situation when all three factors involved in obtaining a perspective representation have been fixed as shown in Fig. 2.

FORMULAE FOR PERSPECTIVE

One standard way of positioning the observer and the picture plane is illustrated in Fig. 3. The observer is situated on the negative z-axis at the point (0,0, −V) looking along the z-axis, and the x-y plane (that is, the plane of the page) is used as the picture plane. This particular combination of positions for the observer and picture plane simplifies the task of obtaining the formulae for the perspective transtormation. Referring to Fig. 3 again, when the point in three dimensions with coordinates (x, y, z) corresponds to the point in the picture plane with coordinates (X, Y) we need only find the relation between these two sets of coordinates to know how to draw the perspective view of any point in three dimensional space. Figure 4 gives a plan view of the situation in Fig. 3, and using the properties of similar triangles it can be seen from this view that the ratio of V to X is the same as the ratio of V + z to x, so that:

$$\frac{X}{V} = \frac{x}{V+z} \qquad \text{OR} \quad X = \frac{Vx}{V+z} = \frac{x}{1+(z/V)}$$

A side view of Fig. 3 will show in the same say that:

$$\frac{Y}{V} = \frac{y}{V+z}$$

so that:

$$Y = \frac{Vy}{V+z} = \frac{y}{1+(z/V)}$$

In this way, we have shown that a point in three dimensions

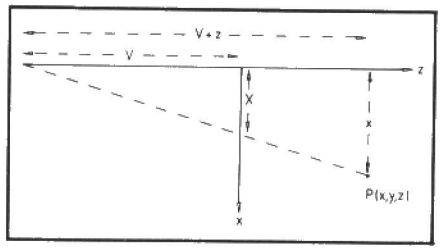

Fig. 4. A plan view of Fig. 3.

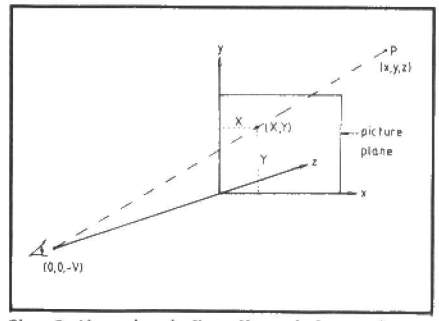

Fig. 3. How to define the picture plane.

with coordinates (x, y, z) corresponds to the point (X, Y) in the picture plane where:

$$X = \frac{x}{1+(z/V)} \quad \text{AND} \quad Y = \frac{y}{1+(z/V)}$$

Now, if an object in three dimensions is described by the points at its corners and the way that these points are joined by lines, then a perspective view of it can be drawn by finding the points in the picture plane corresponding to the corner points of the object and joining them in the same pattern.

DESCRIBING AND DRAWING SOLID OBJECTS

To describe a three-dimensional object we need to organise the data giving the positions of the corners and edges of the object. One way to do this is, for every corner point of the object, to give the location of the point and an indication of whether it is joined by an edge to the previous point. The data is therefore organised into groups of four items. The items can be referred to as X, Y, Z and I with X, Y and Z giving the respective coordinates and I indicating whether there is an edge to this point from the previous one by taking the value 0 if there is no edge and 1 if there is one.

To give an example, the inclined triangle shown in Fig. 5

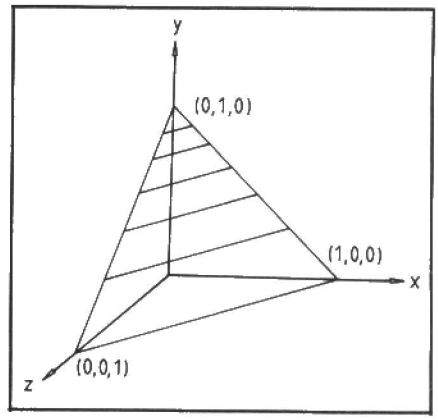

Fig. 5. The inclined triangle.

can be described by the following four groups of data:

X	Y	Z	I
1	0	0	0
0	1	0	1
0	0	1	1
1	0	0	1

Note that even for this simple object the coordinates of one point have to be given twice. This duplication is more marked in complex objects which have more than one edge converging at a corner. The data describing a particular object is not unique. The data for the inclined triangle, as an example, could have been started with the coordinates of any corner of the object.

When the data describing an object is organised in this way, a program to draw the object can be written using the following scheme:

For each group of data items
Read X, Y, Z and I;
Calculate the coordinates of the point in the picture plane corresponding to (X, Y, Z);
(X, Y, Z);

If I = 0 then move to this
If I = 0 then move to this point
else draw a line to this point;

The following program is based on this scheme. In it, N gives the number of groups of data items in the data description and V gives the distance along the negative z-axis of the viewpoint. The graphics commands MOVE and DRAW are used in this program. The command MOVE A, B means move the drawing head to the position (A,B), while DRAW A,B means draw a line from the current position of the drawing head to the point (A,B). The program is:

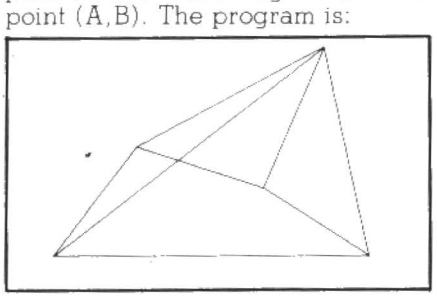

Fig. 6. A wire-frame hexagonal pyramid...

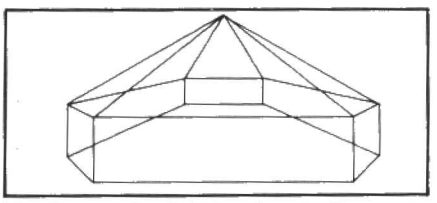

Fig. 7. ...and a tetrahedron in the same style.

```
20 REM SET GRAPHICS MODE
30 FOR K=1 TO N
40 READ X, Y, Z, I
50 XT=X/(1 + Z/V)
60 YT=Y/(1 + Z/V)
70 IF I=0 THEN MOVE XT, YT
80 IF I=1 THEN DRAW XT, YT
90 NEXT K
```

Line 20 must be replaced by the appropriate command such as HGR for the Apple or MODE 4 for the BBC microcomputer. Similarly MOVE and DRAW may need to be replaced by the names used for these commands on your micro.

Figure 6 was drawn by adding the following lines to this program to initialise N and V, and to provide the data:

```
10 N=10: V=5
100 DATA -3,-1,-1, 0, 0, 4, 0, 1
110 DATA  0,-1, 3, 1,-3,-1,-1, 1
120 DATA  1,-1,-4, 1, 0, 4, 0, 1
130 DATA  4,-1, 0, 1, 1,-1,-4, 1
140 DATA  0,-1, 3, 0, 4,-1, 0, 1
```

Figure 7 resulted from changing the values of N and V, and the data with the following lines:

```
10 N=27: V=7
100 DATA  2,-2,-3, 0, 3,-2,-2, 1
110 DATA 1.5,-2, 3, 1,-1.5,-2, 3, 1
120 DATA -3,-2,-2, 1,-2,-2,-3, 1
130 DATA  2,-2,-3, 1, 2,-1,-3, 1
140 DATA  3,-1,-2, 1,1.5,-1, 3, 1
150 DATA-1.5,-1, 3, 1,-3,-1,-2, 1
160 DATA -2,-1,-3, 1, 2,-1,-3, 1
170 DATA  0, 1, 0, 1, 3,-1,-2, 1
180 DATA  3,-2,-2, 1,1.5,-2, 3, 0
190 DATA1.5,-1, 3, 1, 0, 1, 0, 1
200 DATA-1.5,-1, 3, 1,-1.5,-2, 3, 1
210 DATA -3,-2,-2, 0,-3,-1,-2, 1
220 DATA  0, 1, 0, 1,-2,-1,-3, 1
230 DATA -2,-2,-3,1
```

What emerges from this is that the organisation of the data to describe the object is vital to the way in which the figure is drawn. Also, the amount of data needed to describe a figure containing any detail at all can become quite large.

IMPROVING THE APPEARANCE

The drawings in Figs. 6 and 7 do have certain shortcomings in that they do not have the appearance of a solid object. They give a 'wire frame' representaion of an object, and although this gives a good idea of the shape of a solid object it lacks realism because the parts at the back of the object which should be hidden from view are visible. When dealing with a complex object the wire-frame model not only reduces the realism of the drawing but can also cause a clutter of lines from which it is difficult to sort out the actual image. Figure 8 shows a fairly complex object drawn as a wire frame model, and with only the visible parts drawn. In addition, wire frame images can be ambiguous in the sense that they can be seen as more than one sensible image. This can be demonstrated with a wire frame model of a cube, when the intended front can also be seen as the back, and vice-versa, giving a second interpretation to the image.

The way to improve the reality of the wire frame images is to remove, or simply not draw, the lines in the image that are hidden from view. 'Hidden line removal' is a classical problem in computer graphics. We shall tackle it in a restricted form in which comparatively simple objects such as the ones in Figs. 6 and 7 can be dealt with. Our method can handle solid objects that are convex (that is, they have no indented parts or holes) and which are located so that the origin is located inside them.

To try to explain the reason for these restrictions and why they simplify the process of removing hidden lines we should first observe that the reason for a line being hidden from view in reality is that it is obscured by a surface situated between it and the observer. Up to this point our descriptions of objects have involved points and lines only, but now they must be modified to include surfaces. This can be done by listing all the surface facets of an object, and a surface facet can be described by giving the points at its corners that are joined by the edges of the facet.

When dealing with a solid convex object located so that the origin is inside it, there is a fairly simple way to determine whether a surface facet is visible. In fact, a surface facet is visible only if the plane containing it cuts the line from the observer to the origin between these two points. If the plane of the facet cuts this line behind the origin or behind the observer, it is not visible. To see this, first consider vertical facets. The ones at the front which will be visible must lie between the observer and the origin, since the origin is inside the object. A facet at the back of a solid object will be invisible, and it will be behind the origin. Finally, the observer cannot see a facet that is behind him. With inclined planes, those cutting the line from the origin to the observer between them will be visible, although foreshortened, because the top of the facet is still visible above the bottom. If the plane cuts the line behind the origin then it should be invisible because the underside of the surface is towards the observer, and that is the inside surface as far as the solid object is concerned.

Any concavities or indentations would defy this analysis, however.

To summarise this, in order to be able to remove the lines that are hidden from view, we must describe an object in terms of the plane facets on its surface. We can then determine whether each facet is visible by testing where the plane containing it cuts the line from the observer to the origin. Only if the plane cuts the line from the observer to origin between them is the surface facet drawn by plotting its edges. In this way the hidden lines are removed because the edges of an invisible facet are not plotted.

ORGANISING THE DATA

A surface facet can be described by giving the number of its corner points and the positions of these points. A facet described in this way can be drawn by moving to the first point and then drawing the edges to successive points and, finally, also from the last point back to the first one. The data to describe a solid object can therefore be organised to consist of the number of surface facets and, for each facet the number of corner points and their positions. The data to describe the pyramid in Fig. 6 in this way could be:

```
5
3
-3      -1      -1
 0       4       0
 0      -1       3
3
 0      -1       3
 0       4       0
 4      -1       0
3
 4      -1       0
 0       4       0
 1      -1      -4
3
 1      -1      -4
 0       4       0
-3      -1      -1
 4
-3      -1      -1
 0      -1       3
 4      -1       0
 1      -1      -4
```

When a solid object is described in this way, the program scheme for drawing it with hidden line removal is:

```
For each surface facet
    Read number of points on facet;
    Read coordinates of points on facet;
    Determine the plane containing the
    facet;
    Test if plane cuts line from observer
    to origin between them;
    If it does then
        Compute position in picture plane
        corresponding to first point on facet;
        Move to this point;
        For the remaining points
            Calculate corresponding position
            in picture plane;
            Draw a line to this point;
        Draw a line to first point;
```

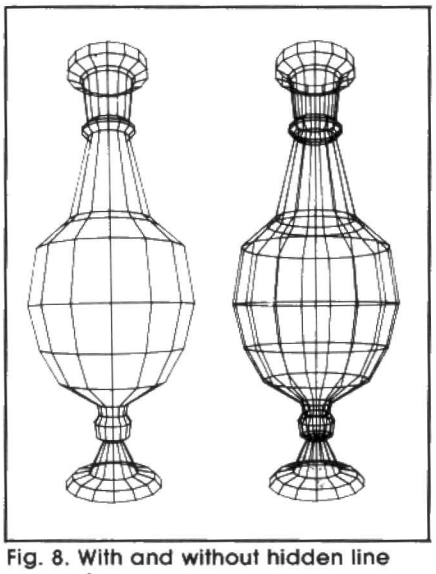

Fig. 8. With and without hidden line removal.

The equation of a plane can be determined from the positions of any three points on it (as long as they are not all in a line) using a standard method from three-dimensional geometry. It has the form:

$$Ax + By + Cz + D = 0$$

If we deal only with the expression:

$$Ax + By + Cz + D$$

from the left-hand side, then this expression will be made zero by substituting the coordinates of any point on the plane in it. Additionally, it will be positive if the coordinates of any point on one side of it are substituted in it, and negative using the coordinates of a point on the other side. Using the coordinates of the origin makes the expression into D, while the location of the observer (O, O, − V) makes it − CV + D. A plane will cut the line from the observer to the origin between the two of them if the two points are on opposite sides of the plane. In this way, the condition that a facet is visible is for D and − CV + D to have opposite signs. This is the same as requiring that (− CV + D)/D = 1 − CV/D be negative.

THE PROGRAM

A program based on the scheme for hidden line removal is:

```
10 DIM X(6), Y(6), Z(6)
20 REM ASSUMING NO MORE THAN
30 REM 6POINTS ON A FACET
40 V=5
50 READ NF
60 FOR I=1 TO NF
70 READ NP
80 FOR J=1 TO NP
90 READ X(J), Y(J), Z(J)
100 NEXT J
110 REM FIND EQUATION OF PLANE
120 X1=X(1) - X(2)
130 Y1=Y(1) - Y(2)
140 Z1=Z(1) - Z(2)
150 X3=X(3) - X(2)
160 Y3=Y(3) - Y(2)
170 Z3=Z(3) - Z(2)
180 A=Y1*Z3 - Y3*Z1
190 B=Z1*X3 - Z3*X1
```

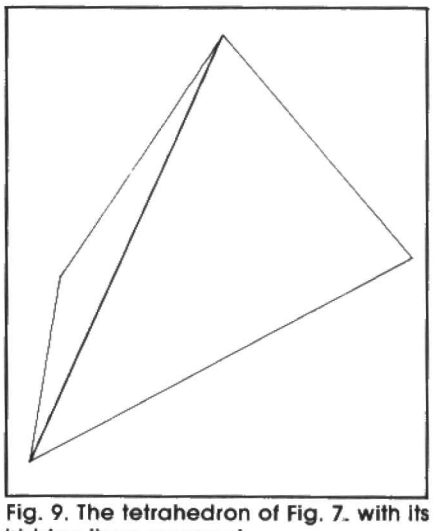

Fig. 9. The tetrahedron of Fig. 7. with its hidden lines removed.

```
200 C=X1*Y3 - X3*Y1
210 D=-(A*X(1) + B*Y(1) + C*Z(1))
220 REM TEST FOR VISIBILITY
230 F=1 - V*C/D
240 IF F>=0 THEN 350
250 REM DRAW VISIBLE SURFACE
260 XS=-X(1)/(1 + Z(1)/V)
270 YS= Y(1)/(1 + Z(1)/V)
280 MOVE XS, YS
290 FOR J=2 TO NP
300 XN=-X(K)/(1 + Z(K)/V)
310 YN= Y(K)/(1 + Z(K)/V)
320 DRAW XN, YN
330 NEXT K
340 DRAW XS, YS
350 NEXT K
```

Figure 9 was produced by adding the following data statements to this program:

```
360 DATA 5
370 DATA 3
380 DATA -3,-1,-1, 0, 4, 0, 0,-1, 3
390 DATA 3
400 DATA -0,-1, 3, 0, 4, 0, 4,-1, 0
410 DATA 3
420 DATA  4,-1, 0, 0, 4, 0, 1,-1, 4
430 DATA 3
440 DATA  1,-1, 4, 0, 4, 0,-3,-1,-1
450 DATA 4
460 DATA -3,-1,-1, 0,-1, 3, 4,-1, 0, 1,-1,-4
```

The data for Fig. 10 was:

```
360 DATA 13
370 DATA 3,  2,-1,-3, 0, 1, 0, 3,-1,-2
380 DATA 3,  3,-1,-2, 0, 1, 0,1.5,-1, 3
390 DATA 3, 1.5,-1, 3, 0, 1, 0,-1.5,-1, 3
400 DATA 3,-1.5,-1, 3, 0, 1, 0,-3,-1,-2
410 DATA 3, -3,-1,-2, 0, 1, 0,-2,-1,-3
420 DATA 3, -2,-1,-3, 0, 1, 0, 2,-1,-3
430 DATA 4,  2,-1,-3, 3,-1,-2, 3,-2,-2, 2,-2,-3
440 DATA 4,  3,-1,-2,1.5,-1, 3,1.5,-2, 3, 3,-2,-2
450 DATA 4, 1.5,-1, 3,-1.5,-1, 3,-1.5,-2, 3,1.5,-2, 3
460 DATA 4,-1.5,-1, 3,-3,-1,-2,-3,-2,-2,-1.5,-2, 3
470 DATA 4, -3,-1,-2,-2,-1,-3,-2,-2,-3,-3,-2,-2
480 DATA 4, -2,-1,-3, 2,-1,-3, 2,-2,-3,-2,-2,-3
490 DATA 6,  2,-2,-3, 3,-2,-2,1.5,-2, 3
500 DATA  -1.5,-2, 3,-3,-2,-2,-2,-2,-3
```

AN ALTERNATIVE TO BASIC

Although the perspective transformation that we have used is

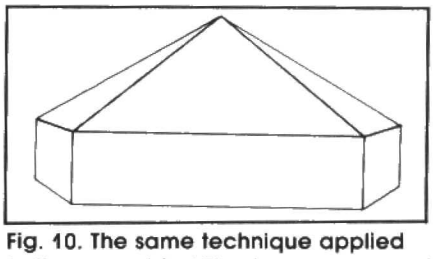

Fig. 10. The same technique applied to the pyramid of Fig. 6. ▶

quite simple, its simplicity derives from the way in which the positions of the observer and picture plane are fixed. A more general perspective transformation with which an object can be viewed from any angle can be derived, but it is a good deal more complex. When using the graphics language GINO-F, however, the general perspective transformation is built into the commands of the language itself. Merely by invoking the appropriate commands for describing a three-dimensional object and for fixing the position of the observer perspective views of solid objects can be obtained from any angle. No detailed knowledge of the mathematics involved is necessary at all.

GINO-F is a library of subroutines for graphics. It is written in FORTRAN, and is used to produce graphics displays by calling the necessary subroutines from a FORTRAN program. The library was originally developed for use with mainframe computers but, despite requiring 134K of storage, it is now available for the Research Machines 380Z. This machine supports Microsoft FORTRAN.

The fundamental graphics subroutines needed to describe and draw perspective views of three-dimensional objects are MOVTO3, LINTO3, VPOINT and VIEW With the first two an object can be described by moving to a point on it with MOVTO3(X,Y,Z) and by drawing an edge with LINTO3(X,Y,Z). In this way the object is described by 'drawing' it in three dimensions. The position of the observer and his direction of viewing as well as the position of the picture plane are fixed by VPOINT (X,Y,Z, XD,YD,ZD,D). The observer is located at (X,Y,Z) and is looking towards the point (XD,YD,ZD) expressed in co-ordinates relative to the observer's position. The picture plane is normal to the line of sight at a distance D from the observer. The subroutine VIEW then invokes the perspective transformation, automatically producing a perspective drawing from the three dimensional drawing description made using MOVTO3 and LINTO3.

The drawing at the bottom left of Fig. 11 was produced by the following program. The other views were produced simply by assigning different values to X, Y and Z and running the program again. The values assigned to these variables for the different views were, in clockwise order from the bottom left:

X	Y	Z
0.0	0.0	−5.0
5.0	5.0	0.0
3.0	2.0	4.0
0.0	5.0	0.3

The program is:

```
X=0.0
Y=0.0
Z=-5.0
D = SQRT(X*X + Y*Y + Z*Z)
CALL HP7220
CALL UNITS(10.0)
CALL SHIFT2(5.0,5.0)
CALL VPOINT(X,Y,Z,-X,-Y,-Z,D)
CALL VIEW
CALL MOVTO3(-3.0,-1.0,-1.0)
CALL LINTO3( 0.0, 4.0, 0.0)
CALL LINTO3( 0.0,-1.0, 3.0)
CALL LINTO3(-3.0,-1.0,-1.0)
CALL LINTO3( 1.0,-1.0,-4.0)
CALL LINTO3( 0.0, 4.0, 0.0)
CALL LINTO3( 4.0,-1.0, 0.0)
CALL LINTO3( 1.0,-1.0,-4.0)
CALL MOVTO3( 0.0,-1.0, 3.0)
CALL LINTO3( 4.0,-1.0, 0.0)
CALL DEVEND
STOP
END
```

The other subroutines are, in the order in which they appear in the program, for setting the device to draw the plot, for establishing the units, to shift the plot into the plotting area and to release the plotting device.

Routines for hidden line removal are not incorporated in GINO-F and so these effects must be programmed from first principles. The GINO-F commands equivalent to MOVE and DRAW are, logically enough, MOVTO2 and LINTO2.

SUMMARY AND CONCLUSIONS

The realistic representation of three dimensional objects can be programmed directly in a microcomputer BASIC that incorporates graphics commands by using the perspective transformation. By conveniently fixing the locations of the observer and the picture plane the formulae for the perspective transformation can be obtained quite simply. With its aid perspective views of wire-frame models of solid objects can be produced by fairly short programs.

However, by using the graphics language GINO-F three-dimensional images can be produced without any mathematical knowledge at all on the part of the user. The facilities for describing solid objects and producing perspective views of them are embedded in the language. In this way, a straightforward entry to three-dimensional graphics is available to the non-mathematical user.

Although wire-frame images provide a good idea of the shape of a solid object, they do have shortcomings as realistic representations of the views of solid objects. The method of hidden line removal can be used to give images of improved realism. To understand and implement a method for hidden line removal probably does require some mathematical sophistication, even for the restricted type of problem considered here. The method presented here fits very well with the perspective transformation we have used. However, it must be remembered that it only works with convex objects situated so that the origin falls within their interior.

Finally, whether we are drawing wire-frame models or removing the hidden lines from drawings, it should be clear that the way in which the data describing the solid object is organised is of great importance. A well-organised data description will simplify the graphics program using it, thus helping in developing the program as well as in understanding it once it is written.

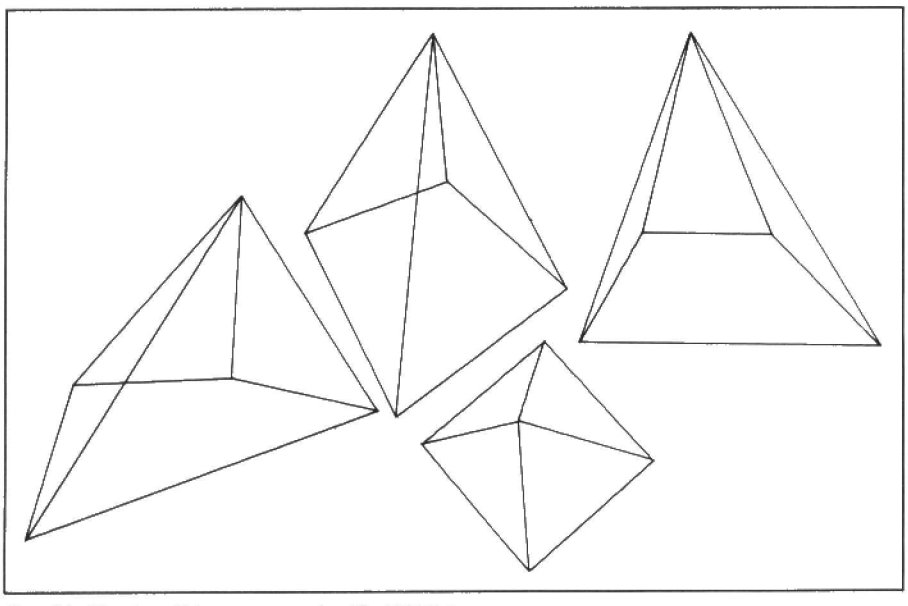

Fig. 11. Moving things around with GINO-F.

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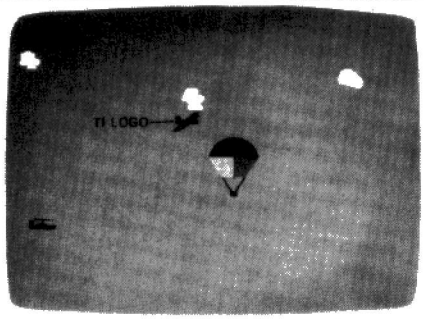
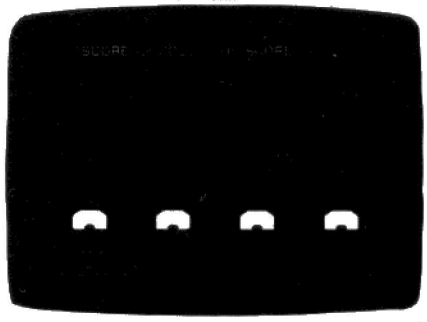


The TI 99/4A Home Computer



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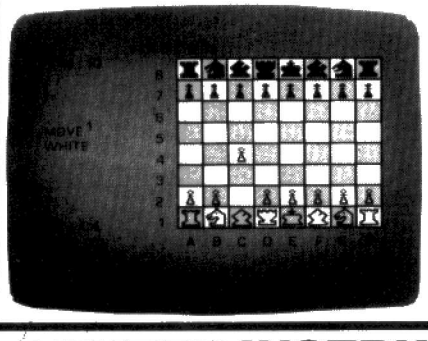

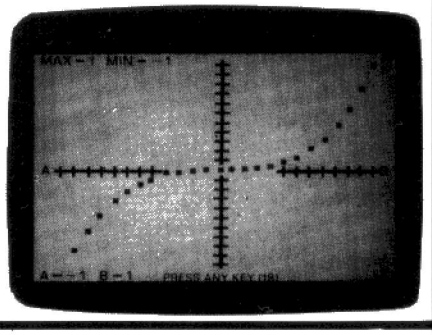

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VIC FORMAT CONVERTER

Make your listings appear in the easy-to-read Computing Today format.

Understanding other peoples' program listings is never an easy task — even understanding your own can sometimes get pretty hairy. But things become doubly difficult if the computer in question uses its own special symbols for representing control functions and graphics pharacters. Thankfully, at least as far as ***Computing Today*** is concerned, a standard has been devised for published listings which uses a common format for all machines.

The CT rules themselves need no explanation from me — they are in any case regularly featured towards the rear of the magazine. However, whilst the submission of a program in this standard format is good news for CT's readers (which is, after all, what it's all about), it can pose something of a problem for the author, particularly in the case of larger programs using lots of graphic and control commands. The problem is that in order to convert the special graphic symbols into standard CT codes the source program has to be amended before being dumped to a printer. The listing thus converted will now be far easier to read and understand, but it will not, as it stands, be a RUNable program. For example, the BASIC statement:

```
10  PRINT"
```

would under CT rules, be converted to:

```
10  PRINT"[20 SPC]"
```

Now to you and I they both mean the same thing, the only difference being that the latter form is much easier to read. But it is quite obvious that they are not literally the same. The second statement is not a RUNable program to PRINT twenty blank spaces — is it? And, if a listing is not a direct dump of a RUNable program, then great care must be taken to ensure that one or three 'bugs' don't creep in during the eminently worthwhile but undeniably tedious process of conversion to standard format.

What we really need is something which can produce a listing in standard CT format without any alteration to the coding of the source program.

AUTOMATIC FORMATTING

The automatic formatting method described below was devised for a VIC-20. I chose the VIC firstly because it uses a large number of special graphics characters, secondly because it is one of the most popular personal computers, and last, but not least, because it's the only computer I've got.

The program itself fits comfortably into the unexpanded 3.5K model, but is equally at home with any size RAM expansion. It is not dependent on any particular configuration of the screen RAM and no modifications whatever are required.

If a printer is connected the program assumes it to be the standard VIC 1515 machine. I cannot guarantee the program will work with non-standard printers or RS232 devices since I don't have one myself. However, any changes should be of a very minor nature. If no printer is connected the program will output the formatted listing to the screen only.

The program works by copying the source code of the object program to a blank cassette tape as an ASCII data file. On Commodore machines this is simplicity itself using the CMD command. CMD redirects output that would normally go to the screen to another specified peripheral device — in this case the cassette recorder. Once the listing has been dumped onto the tape, it can be read back into the computer and reprocessed to convert the VIC's odd graphic symbols into standard CT codes.

The complete formatting operation is detailed in Table 1, which is intended as a sort of 'user instruction sheet'. You will see that the program is really in two main sections:

i) A series of direct commands entered at operating system level.
ii) A BASIC program called 'VIC -CT FORMAT'.

Please note that the PRINT#1 statement in paragraph (d) should not be entered using the abbreviated '?' form. PRINT and PRINT# are regarded as distinctly different commands by the VIC's BASIC interpreter.

THE FINISHED PRODUCT

To demonstrate how effective the converter can be, I have included two listings of a demonstration program. The program doesn't actually do anything useful — it is merely a device for indicating the way in which the VIC's listings can become a nightmare to decipher.

Program 1 is the listing as the VIC would normally produce it. Program 2 is the same program — no alterations have been made to the source code — but in this case the listing was produced using the format converter. I believe the results speak for themselves.

Finally, although I admit I haven't tested it, the technique used by the converter should apply equally well, with some slight modifications to the program, to other Commodore machines. VIC BASIC and PET BASIC are, after all, very similar.

So there you are, Commodore users. Now you really haven't any excuse for submitting programs in non-*Computing Today* format.

```
9 REM ** ALPHANUMERICS
10 PRINT"ABCDEFGHIJKLMNOPQRSTUVWXYZ0123456789"
11 REM------------------------------------------------------------
19 REM ** NORMAL NON-ALPHA-NUMERIC CHARACTERS
20 PRINT"+!#$%&'()+-£@*↑π:;[]=,./<>?"
21 REM------------------------------------------------------------
29 REM ** COLOUR KEYS
30 PRINT"[illegible]"
31 REM------------------------------------------------------------
39 REM ** USER FUNCTION KEYS
40 PRINT"[illegible]"
41 REM------------------------------------------------------------
49 REM ** SPECIAL CONTROL FUNCTIONS
50 PRINT"[illegible] "
51 REM------------------------------------------------------------
59 REM ** GRAPHICS ON 'RIGHT-SHIFT' KEY
60 PRINT"[illegible]"
65 PRINT"[illegible]"
70 PRINT"[illegible]"
80 PRINT"[illegible]"
81 REM------------------------------------------------------------
89 REM ** GRAPHICS ON 'LEFT-SHIFT' KEY
90 PRINT"[illegible]"
100 PRINT"[illegible]"
110 PRINT"[illegible]"
120 PRINT"[illegible]"
121 REM------------------------------------------------------------
129 REM ** SYMBOL REPETITION
130 PRINT"       [illegible]"
131 REM------------------------------------------------------------
```

Program 1. A demonstration program showing the special symbols the VIC uses to represent control functions and graphic characters.

```
9 REM ** ALPHANUMERICS
10 PRINT"ABCDEFGHIJKLMNOPQRSTUVWXYZ0123456789"
11 REM------------------------------------------------------------
19 REM ** NORMAL NON-ALPHA-NUMERIC CHARACTERS
20 PRINT"+!#$%&'()+-£@*↑π .[]=,./<>?"
21 REM------------------------------------------------------------
29 REM ** COLOUR KEYS
30 PRINT"[BLK][WHT][RED][CYN][PUR][GRN][BLU][YEL]"
31 REM------------------------------------------------------------
39 REM ** USER FUNCTION KEYS
40 PRINT"[F1][F2][F3][F4][F5][F6][F7][F8]"
41 REM------------------------------------------------------------
49 REM ** SPECIAL CONTROL FUNCTIONS
50 PRINT"[HOM][CLS][CD][CU][CR][CL][REV][OFF][SPC]"
51 REM------------------------------------------------------------
59 REM ** GRAPHICS ON 'RIGHT-SHIFT' KEY
60 PRINT"[G>+][G>-][G>£]"
65 PRINT"[G>Q][G>W][G>E][G>R][G>T][G>Y][G>U][G>I][G>O][G>P][G>@][G>*]"
70 PRINT"[G>A][G>S][G>D][G>F][G>G][G>H][G>J][G>K][G>L]"
80 PRINT"[G>Z][G>X][G>C][G>V][G>B][G>N][G>M]"
81 REM------------------------------------------------------------
89 REM ** GRAPHICS ON 'LEFT-SHIFT' KEY
90 PRINT"[G<+][G<-][G<£]"
100 PRINT"[G<Q][G<W][G<E][G<R][G<T][G<Y][G<U][G<I][G<O][G<P][G<@][G<*]"
110 PRINT"[G<A][G<S][G<D][G<F][G<G][G<H][G<J][G<K][G<L]"
120 PRINT"[G<Z][G<X][G<C][G<V][G<B][G<N][G<M]"
121 REM------------------------------------------------------------
129 REM ** SYMBOL REPETITION
130 PRINT"[7SPC][5CD][REV][13G<B][OFF][RED][7CU][6CR][HOM]"
131 REM------------------------------------------------------------
```

Program 2. The same program using Computing Today standard codes.

a) LOAD object program into computer in the normal way.
b) Rewind and remove object program. Failure to do this will result in object program being over-written.
c) Insert a blank data tape in the cassette recorder.
d) Type for following statements at command level. Terminate each statement with a 'Carriage Return'.

Statement	Function
OPEN 1,1,1	A file 'header' is written to the tape.
CMD1	All screen output will now be directed to the cassette device.
LIST	A copy of the object program is written to the tape as an ASCII data file

When the 'write' operation has been completed:

PRINT #1 CLOSE 1 NEW	This ensures that the data file is CLOSEd correctly, and further output is directed back to the screen.

e) Rewind and remove the data tape.
f) Now LOAD the program 'VIC-CT FORMAT' and RUN it. The program will remind you to rewind and remove the 'VIC-CT FORMAT' tape and insert the data tape you just created. Finally you will be asked to indicate whether the VIC printer is connected.

If no printer is present the program will display the formatted listing on the screen four lines at a time. Otherwise, the complete listing will be output to the printer.

Table 1. VIC-CT format converter instruction card.

Variable	Function
PR$	Flag indicting a printer is connected.
QU	'QUOTES' flag.
RY	BASIC 'READY.' message flag — used to indicate the end of the source program listing.
LI	Screen line-counter — used to halt scrolling when printer is not connected.
A$	Single character input from ASCII data file.
AV	ASCII value of A$.
X$ Y$	Temporary stores for tape input during check for symbol repetition.
CN	Counter for graphic/control symbol repetition.
CN$	String representation of graphic/control symbol repetition.
CH	ASCII value of graphic/control symbol.
CH$	Representation in CT format of graphic/control symbol.
OK$	General purpose single character keyboard input.

Table 2. Variables used within 'VIC — CT format' program and their functions.

```
10 PRINT"[CLS][5CD][2SPC]REWIND[SPC]AND[SPC]REMOVE":PRINT"[CD][4SPC]PROGRAM
   [SPC] TAPE":GOSUB550
20 PRINT"[CLS][5CD][2SPC]INSERT[SPC]SOURCE[SPC]TAPE":GOSUB550
30 PRINT"[CLS][5CD]IS[SPC]A[SPC]PRINTER[SPC]CONNECTED":PRINT"[CD][7CR]Y
   [SPC]OR[S PC]N"
40 GETPR$:IFPR$="N" THEN 70
50 IFPR$<>"Y"THEN 40
60 OPEN2,4:REM**OPEN PRINTER CHANNEL
70 OPEN1,1,0:REM**OPEN TAPE CHANNEL
80 QU=0:RY=0:LI=0
90 PRINT"[CLS]"
100 B$="":CN$=""
110 GET#1,A$
120 IF ASC(A$)=13 THEN 200
130 AV=ASC(A$)
140 IFAV=34 THEN QU=QU+1:IFQU=2 THEN QU=0
150 IFQU=0 THEN 180
155 IFAV=255THEN180:REM**THIS IS 'PI'
160 IFAV>191 THEN AV=AV-96
170 IFAV>95 OR AV<33 THEN 270
180 B$=B$+A$
190 GOTO110
200 IF RIGHT$(B$,6)<>"READY." THEN 240
210 RY=RY+1:IF RY<2 THEN 260
220 IF PR$="Y" THEN GOSUB600:CLOSE2
230 CLOSE1:END
240 IF PR$="Y" THEN PRINT#2,B$:PRINT B$:CN=1:CN$="":GOTO100
250 PRINT B$:CN=1:CN$="":LI=LI+1:IF LI=4 THEN GOSUB550:LI=0
260 GOTO100
270 X$=A$
280 GET#1,Y$
290 IF X$=Y$ THEN CN=CN+1:A$=Y$:GOTO270
300 AV=ASC(A$):IF AV=255 THEN 310:REM**THIS IS 'PI'
305 IFAV>191THENAV=AV-96
310 CN$=STR$(CN):IF CN=1 THEN CN$=""
320 IF CN<>1 THEN CN$=RIGHT$(CN$,LEN(CN$)-1)
330 IF AV>96 AND AV<123 THEN A$="["+CN$+"G>"+CHR$(AV-32)+"]":GOTO370
340 GOSUB380
350 IF LEFT$(CH$,1)="<" OR LEFT$(CH$,1)=">" THEN A$="["+CN$+"G"+CH$+"]":
    GOTO370
360 A$="["+CN$+CH$+"]"
370 B$=B$+A$:A$=Y$:CN=1:GOTO120
380 RESTORE
390 READ CH,CH$:IF CH=999 THEN RETURN
400 IF CH<>AV THEN 390
410 RETURN
420 DATA 5,WHT,17,CD,18,REV,19,HOM,28,RED,29,CR
430 DATA 30,GRN,31,BLU,32,SPC,96,>*,123,>+
440 DATA 124,<-,125,>-,126,π,127,<*,133,F1
450 DATA 134,F3,135,F5,136,F7,137,F2,138,F4,139,F6
460 DATA 140,F8,144,BLK,145,CU,146,OFF,147,CLS
470 DATA 156,PUR,157,CL,158,YEL,159,CYN,160,SPC
480 DATA 161,<K,162,<I,163,<T,164,<@,165,<G
490 DATA 166,<+,167,<M,168,<£,169,>£,170,<N
500 DATA 171,<Q,172,<D,173,<Z,174,<S,175,<P
510 DATA 176,<A,177,<E,178,<R,179,<W,180,<H
520 DATA 181,<J,182,<L,183,<Y,184,<U,185,<O
530 DATA 186,>@,187,<F,188,<C,189,<X,190,<V,191,<B
540 DATA 999,ERROR
550 PRINT"[HOM][20CD][REV][PUR]HIT[SPC]ANY[SPC]KEY[SPC]WHEN[SPC]READY[OFF]
    [BLU]"
560 GETOK$:IFOK$="" THEN 560
570 PRINT"[HOM][20CD][22SPC][20CD][HOM]"
580 RETURN
600 PRINT#2:PRINT#2:PRINT#2
610 PRINT#2,"THIS[SPC]LISTING[SPC]WAS[SPC]PRODUCED[SPC]USING[SPC]THE[SPC]
    VIC-CT[SPC]FORMAT[SPC]CONVERTER"
620 RETURN
```

Listing 1. The 'VIC-CT format' program.

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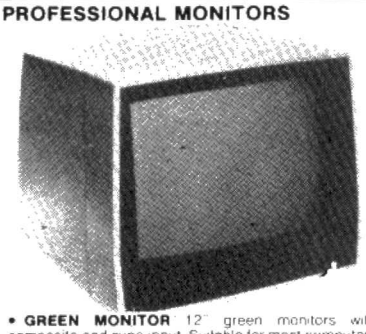

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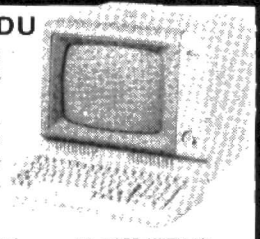

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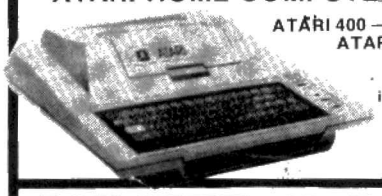

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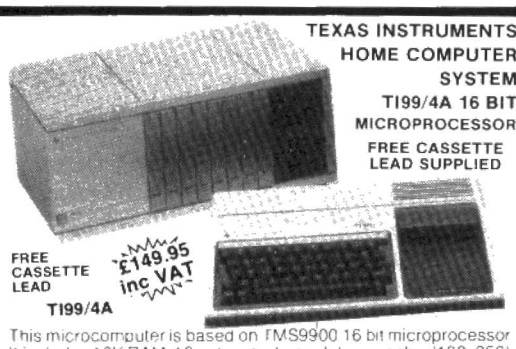

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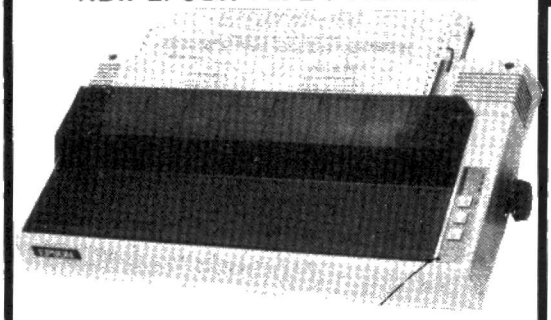

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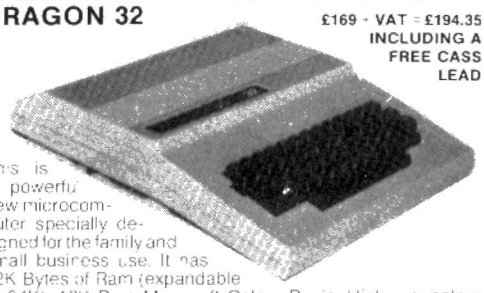

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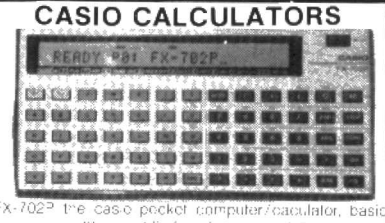

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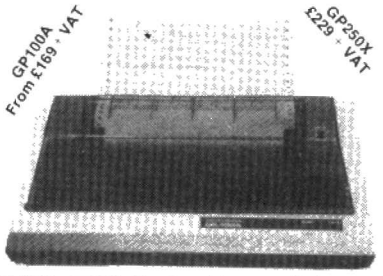

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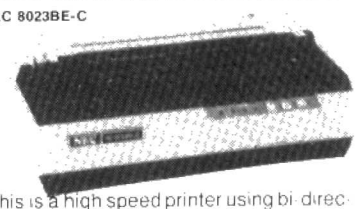

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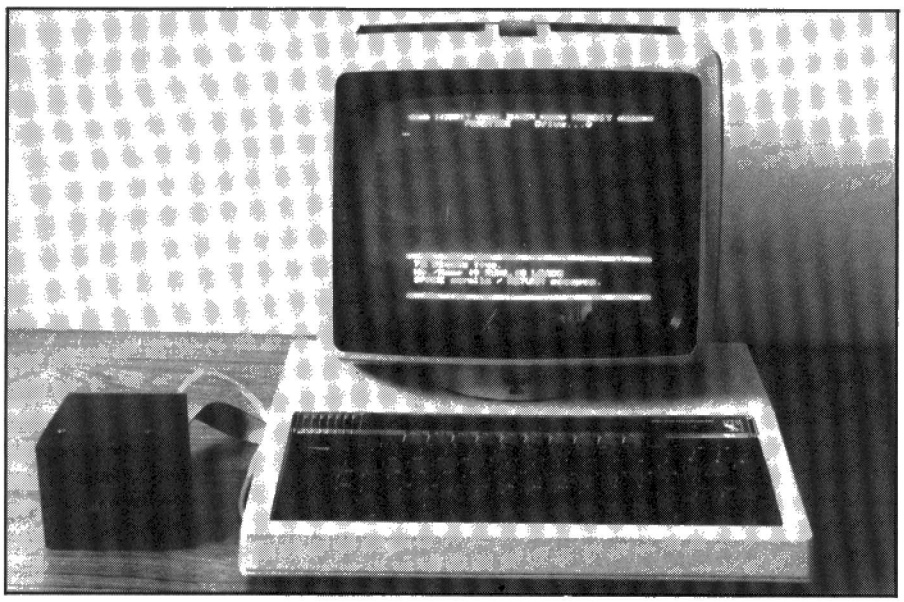
Henry Budgett

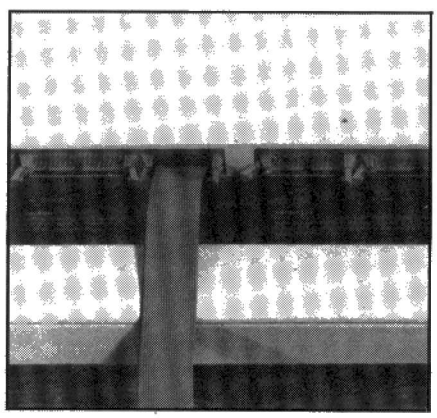
SPECIAL REPORT # 2

If tapes take too long to load on your BBC Micro and you cannot afford discs then perhaps the Hobbit drive could save both money and time.



For the domestic BBC Micro user there must come a point when the realisation dawns that cassettes are just not going to be of use any more. The commercial user has already moved on to discs either through the BBC's own drives or with the Torch disc pack but the home user has been content to struggle with the 1200 baud cassette system. The problem is, however, how can one justify buying something that costs nearly as much as the computer did? So, is there another way of adding a mass storage system onto your computer that will be faster than tape, as easy to use as discs and yet still leave you with both arms and legs attached? The answer may well lie in a device called the Hobbit from Ikon Computer Products. It's not actually a new device, it has been available for the NASCOM for around a year and the Philips digital cassette mechanism it uses is even older but this is the first time that it has been implemented with a complete operating system. And, at £135 plus VAT it appears to be ideally placed between the existing tape system and the expensive disc.

The Hobbit arrives as a black metal and plastic cube some 90mm by 95mm by 110mm with the tape loading door at the front, four rubber feet at the bottom and two sockets at the back. Also included in the package are a manual, two leads and a PROM containing the device's operating system. Both cables are fairly short, indeed the data cable was somewhat shorter than the power lead, which means that the unit has to stand fairly close to the BBC Micro but that's not too much of a problem. The standard cable set will cater for two drives which means that expansion to a dual drive system only requires the purchase of a second Hobbit, the operating system will happily handle both. The cassette supplied with our review drive was, although of exactly the same size as a dictation machine tape, of digital quality rather than audio and given the speed that the system operates at I would highly recommend that these are used even though they do cost nearly £3 each.



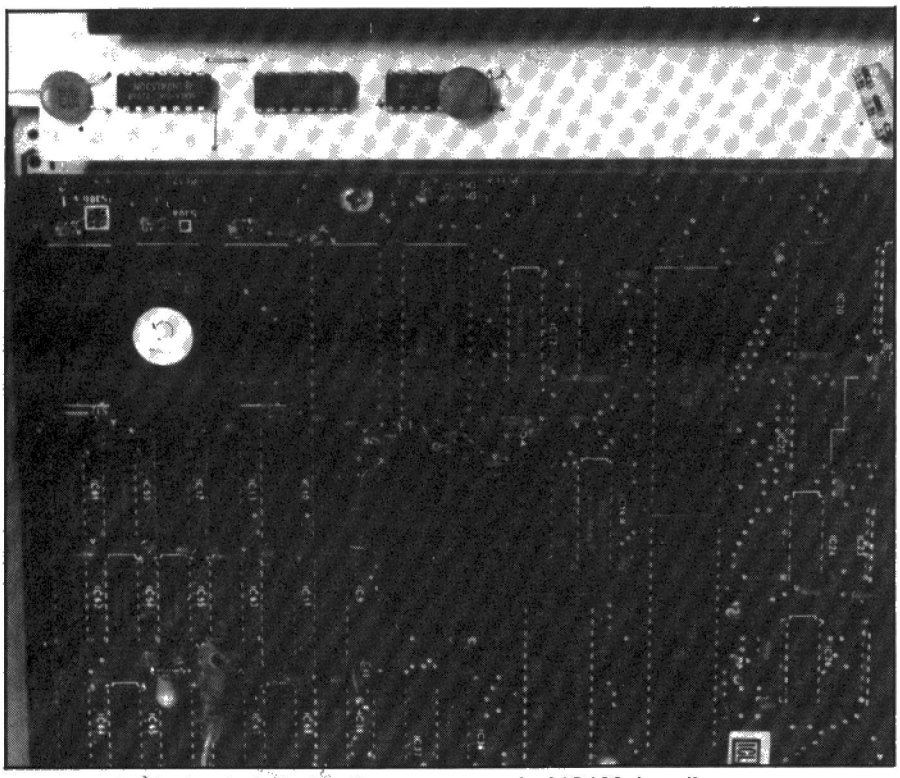
The user port connection is a standard insulation displacement type cable.

GETTING IT GOING

I would have loved to have been able to describe the installation of our Hobbit as an easy task. However, it isn't. Mainly this is the fault of the manual, of which more later, rather than the basic ideas behind the system. If you have any worries about opening the box of your precious BBC Micro then you can send the whole lot to Ikon and they'll install it for a £5 note (plus VAT of course!). If you have no qualms about opening the box then the installation will take some five to ten minutes of your time but don't rush it or you could damage your micro.

The first task is to make sure that the power is off and the plug is removed from the socket. Now remove the top cover of the BBC Micro and the keyboard assembly, a total of four screws and three nuts and bolts. You should be able to see the ROM socket area at the front of your machine on the right-hand side. The ideal place to fit the operating system PROM is IC100 but it can go in IC101 or IC88 if required. Plugging the PROM in is quite hard work the sockets Acorn chose are not the nicest, so make very sure that all the pins are straight on the chip before you give it that final push home. Depending on where the PROM has been fitted you will now have to re-position one of two links and possibly cut the lead on one component. Now you can re-assemble the keyboard and case and proceed to plug the leads in.

First to go in is the data lead which fits into the user port socket underneath the micro, this should be locked into place with the clips provided on the socket. The other end of this lead goes to the socket at the back of the Hobbit. The power cable fits into the somewhat precarious auxiliary power socket under the micro and care must be taken to ensure that the polarising lug on the plug is on the side nearest to the computer or spectacular ▶



The HOS ROM being installed in the recommended IC100 location.

damage may result. In theory it shouldn't be possible to plug it in the wrong way round but... With the power cable attached to the Hobbit you can now turn everything back on.

THE MOMENT OF TRUTH

Instead of the familiar, friendly greeting from the BBC Micro on the screen you should now have the following:

```
BBC COMPUTER
HOS V1.2 (C) L.J.WANT & A.A.WANT 1983
IKON...TEL 099 421 515
BASIC
```

which indicates that all is well. If you don't get this then turn off and check everything again very carefully!

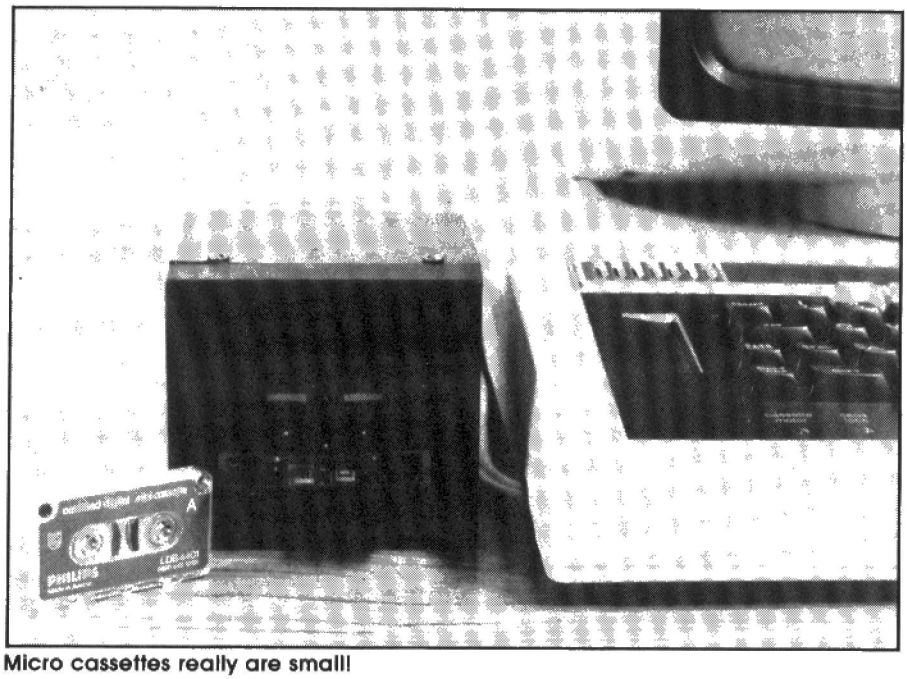
What you now have is a very fast tape system which will obey (almost) all the commands that you have previously used on the cassette tape system. However, there is one major change to be made to the way you operater. Each blank tape must first be intitialised and each side of the tape needs to be given a unique name. This is achieved by using the *FORMAT FFF command which initalises the tape and gives it a volume name which can be up to eight letters specified by FFF. As a confidence check type *CAT once you've formatted a blank tape and this will show you what's on it. Don't be perturbed by the noises coming from the Hobbit drive, it's under complete control of the ROM and knows what it's doing!

MAKING USE

The sheer speed of operation of the Hobbit should totally change the way you use your BBC Micro in that the handling of large data files etc becomes a realistic operation and doesn't take all day. All the basic operating system commands you used to use on cassette are present and correct (with one exception that I'll cover in a moment) so you can SAVE and LOAD programs as normal. However, to add to the facilities there are a number of extra functions available. The catalogue of programs stored on the tape can be accessed directly from the index display so it is possible to *CAT the tape and then simply type either the name or file number of the program you want and press f8 to LOAD or f9 to LOAD and RUN. If you want to return to the conventional cassette system then *TAPE will achieve this or you could simply type *BBC and the Hobbit Operating System (HOS for short) disappears completely (*HOBBIT will get it back after a *TAPE but only a Break will restore it from a *BBC command). Later versions of the PROM have changed the *BBC to 0 and Break, the function is the same.

The *LOAD, *SAVE, *RUN, *SPOOL and *EXEC functions are all implemented as usual and should need no further comment from me. However, there are a number of totally new functions available which the cassete user will not have encountered. *COPY will either duplicate a file on the same drive or copy a file onto a second drive. This is the first command that incorporates the @ Inhibit Check symbol. If you are copying a file and the HOS finds that there is already a file with that name in the catalogue it checks with the first to make sure you wish to overwrite the existing file. You can also suppress this check so it does it automatically. You can *RENAME files on the tape, *DELETE a single file or *KILL the whole tape. Once a file is deleted it isn't removed from the tape, merely struck out of the index list so Ikon have thoughtfully provided a *RECOUP command to recover the last file deleted. This only works if you do it immediately as a SAVE or *SAVE will overwrite the actual file area and all will be lost. One of the apparent quirks of the Hobbit system is that, because it works on the directory or index system, it can appear to take longer to LOAD something than it took to SAVE it or, indeed, vice versa. This is because it has to look up the file in the directory and then spool through the tape until it reaches the correct point. This shouldn't be much of an inconvenience as the transfer rate for information is 750 bytes per second, compare that to the fastest BBC cassette speed of 120 bytes per second and you'll see why Ikon claim that it is halfway between tape and disc in operating speed. Each tape can hold around 100K of information with a maximum of 138 files.

It is in the area of files, specifically data files, that the small differences between the HOS and the BBC's Cassette Operating System or COS occur. The commands affected are the OPENIN and OPENOUT file operators. Under the HOS they have the same function and need to be qualified with one of the four control codes provided. The default values for OPENIN and OPENOUT are different in that the first gives access for both reading and writing and the latter only provides write access to the file. However, the OPENIN command can be restricted to either read or write only by using the W or R control code. The major problem is that while the Hobbit can handle up to five files simultaneously it only initialises sufficient buffer space for two. Yes, even the Hobbit eats more your precious RAM and, as anyone who has read Tolkien's saga knows, they like regular feeding! Each buffer must be 750 bytes so the initial memory loss is some 1.5K which is less than discs would take but still painfully expensive for the user. With all five file buffers initialised, the manual tells you how, you've lost nearly 4K of user



Micro cassettes really are small!

memory so it is well worth making sure that you are doing things as efficiently as possible when dealing with data files.

THE BOOK OF WORDS

The manual is a poor thing indeed. Currently standing at some 16 pages of poorly laid out and, even worse, badly thought out A5 sheets it doesn't do the Hobbit justice at all. The instructions for installation are not good, it doesn't even appear to warn you to turn the BBC Micro off before you start, and the diagram showing the location of the various components is a hand drawn scrawl. A re-write and re-packaging operation is called for here, decent examples should be included and it would be helpful if someone checked the spelling too. It would also be nice if Ikon could see their way to including some of the routines for data file handling on a tape and supplying this with the rest of the package as this area is the least well explained of the lot and yet will probably be the reason many home users buy the system.

TECHNICALLY SPEAKING

The idea of using a very fast digital cassette for personal computers is not exactly new. Indeed, the Philips drive that the Hobbit uses has been around for some three years now but has seldom been implemented. Ikon themselves produced a naked module for the NASCOM range of computers last year which seemed to gain some acceptance but everyone else carried on with the domestic cassette. This year, however, we have seen the Epson HX-20 and the Sharp PC-1251 making use of the micro cassette and there are others to come too. The advantages to be gained are enormous, in terms of speed of operation, physical size and the power of the operating system that can be provided it has no match in tape based form. Hybrid devices such as Sinclair's long awaited Microdrive and the BATS/NCI 3" disc have yet to be proven in terms of reliability and don't exist in sufficient quantity. The question that must be asked is whether Ikon have managed to link the micro cassette to the BBC Micro in the best possible way. There are areas where they appear to have run into problems and, sadly, not actually told anyone about it. Because the tape needs a timing signal written onto it to enable it to find any program or data file Ikon 'borrow' the BBC's timer and corrupt its contents. It should have been possible to use the system clock and to generate a timing signal within the Hobbit rather than to mess up a system variable. The other reported area of complaint is that the Control B copy facility fails to operate as normal when the Hobbit is installed. I couldn't establish the truth of this claim and Ikon reckon that it doesn't happen, at least not with their serial printer. If it is correct that this facility is disabled then it would be kind of Ikon to warn us and explain how to get around it with the VDU2 and VDU3 commands, see pages 404-408 of the **User Guide.** Apart from these niggles they appear to have provided as good an implementation of the unit as possible.

CONCLUSION

Given that your usage of the BBC Micro is being limited by the amount you can store and access within a reasonable time and that you either cannot afford discs or simply don't think that you really need them then the Hobbit is probably your only alternative. It really is halfway between the two in terms of price, speed and capabilities. My only regrets are that the appearance and usability of the excellent Philips drive are let down by a shoddy casing, a poor manual and a generally unprofessional appearance to the whole thing. Given a nice case, a better manual and an overall uplift in quality it deserves to succeed as the price is right and the HOS is flexible enough to satisfy the market for which it has been designed. Ikon could, given a little attention to detail, have a real winner on their hands provided, of course, someone else doesn't beat them to it with a 3.5" Sony-type drive!

FACTSHEET

Drive	Ikon Hobbit
Speed	Philips digital micro cassette
Capacity	750 bytes per second
Access time	50K per side
No of files	25 seconds average
Buffer size	130 total 5 active simultaneously
	750 bytes per file 2 buffers intialised automatically
Costs	£135.00 plus VAT £17.50 plus VAT per six tapes
Supplier	Ikon Computer Products Kiln Lake Laugharne Carmarthen Dyfed SA33 4QE 099421-515

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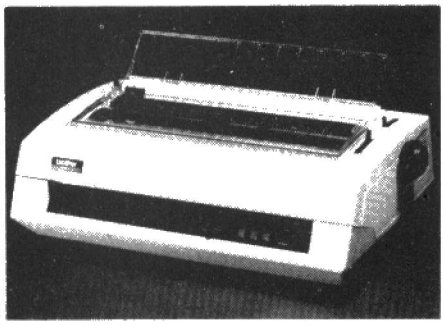

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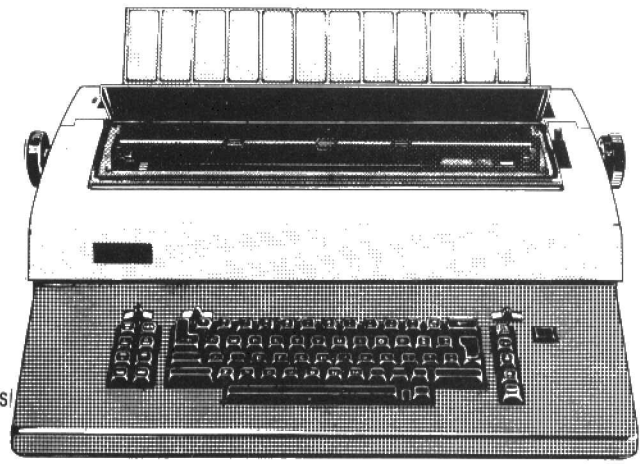

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PRINTOUT

Dear Sir,

I read with interest the letter from G T Richings of Guildford in the April issue as I have also tried the VIC Blow Up program with the same results and problems of Mr Richings. But your answer will not cure his problem as I have an unexpanded VIC and it does the same. After several frustrating hours of 'playing' I gave up. Any thoughts?

Yours faithfully,
S Devonport
Hounslow

(*Er, no. Ours works fine — sure you haven't miskeyed anything? Ed.*)

Dear Sir,

I would like to thank you for publishing my Naspen Append article in your excellent magazine (April edition). I noticed one mistake though in the blurb about how to use the utility. To send ZEAP output to the serial interface or the UART you must type: U M N <Enter> . The M and N in the article had accidentally been swopped.

Something I must point out is that the source listing I sent to you had comments included but the printed article did not have them. When I started to learn machine code I found other peoples' comments invaluable so why omit them?

Yours faithfully,
A G Heal
Kenilworth

(*Apologies for swopping the M and N. The only reason for not including your comments was one of physical size and I felt that the program was still invaluable without them. Ed.*)

Dear Sir,

The letter from P H Sidwell carried in your May issue which launched an attack on BASIC has prompted me to write to you. This is not because I necessarily disagree with the views expressed, indeed they can be boiled down to the fact that the author having mastered Pascal prefers the latter personally, but because I feel that some sense of proportion needs to be injected into the 'which is the 'best language' debate'. Let us refresh our memory as to why we have high level languages in the first place.

Computers communicate in strings of numbers, not even indeed in numbers that people are used to. Although people could talk to computers in the latter's own language it would be cumbersome and difficult to learn and remember since people are not accustomed to communicating in numbers. Consequently we devise high level languages to enable us to talk to computers in our terms. Since computers are our tools this seems reasonable.

It follows from this that high level languages should be people orientated and it would seem that more people find BASIC suits the way they think than any other language yet devised. Of course BASIC is inefficient and slow in terms of the computer but since computers and human thought processes have little in common it would be amazing if a language which people found easy were other than inefficient in this sense. Conversely, very efficient languages, for example the beautiful FORTH, are likely to be heavy going for people.

Judged overall, therefore, at the moment most people find BASIC the best language for them to communicate with computers in. Naturally if more efficient use of memory and speed are sought then alternatives will be needed but most people find BASIC adequate. Such a language, which might be described as highly people orientated, is inevitable and indeed essential in a world where the man in the street programs computers. The question as to which language individuals find most intelectually satisfying or which language professional programmers feel best meets some perceived criteria of elegance is quite irrelevant. In the next generation the specialist programmer will be a specialist indeed, routine programs will be written by users.

The 'best language' is the one that will do the job for you whether it is elegant or not. Many people feel that for them the answer is BASIC at present. Maybe if the human race as a whole learns to think in a structured way at some time in the future Pascal will become the new BASIC but the consequences of this change would be far more significant than a change in the favourite computer language.

Yours faithfully,
Alan J Powley
Midlothian

Dear Sir,

Unfortunately in the Valley modification for the ZX Spectrum that you published in the April issue some lines were omitted. The program listing should be:

```
3875  PRINT AT W1,W2;OVER 1;N$(RF1)
3876  PRINT AT M1,M2;OVER 1;CHR$ Q
3877  LET M1=W1:LET M2=W2
3878  PRINT AT M1,M2;OVER 1;CHR$ Q
```

For those who have adapted Brian Hick's spells for their ZX Spectrums, the special effects can be achieved by using:

```
PRINT AT W1,W2;OVER 1;"(*8)"
```

with FLASH 1 and/or BRIGHT1 to produce a blinding light in the 'dispel evil' and 'Dantor' routines. Temporary invisibility is achieved by:

```
PRINT AT M1,M2;OVER 1;CHR$ Q
```

in place of the calls to subroutine 60119 in the disappearing spell. Onwards, ever onwards, deeper into The Valley.

Yours faithfully,
Kevin Hyman
Swindon

Dear Sir,

I was interested to see Ultima appear in **Personal Software** *Spring 1983 as a computer program, but you should have given me credit as the inventor of this game. Perhaps your writer didn't realize the game had an inventor (or at least a known inventor). Ultima appeared in my book* **ABBOTT'S NEW CARD GAMES,** *which was published in Britain about twenty years ago.*

If any readers have tried Ultima, they might be interested to know about a couple of rather fatal flaws that have been uncovered in the game. The first is that most

pieces (except for the Withdrawer and the Immobilizer) are only effective against enemy pieces that have moved into the centre of the board. The best strategy, then, is not to move towards the centre or, in effect, to do nothing. Once both players have realized that doing nothing is the best strategy, the game does lose a certain interest.

The other flaw, as if the first flaw isn't bad enough, is that the pieces (again except for the Withdrawer and the Immobilizer) lack clarity. It's hard to see when you are under attack, thus it's hard to look forward more than a couple of moves.

In spite of these flaws, I haven't given up on Ultima and every now and then I experiment with various revisions. If anyone can suggest alternate pieces — ones that are clear in what they are doing and ones that are effective against undeveloped enemy pieces — I'd appreciate hearing from you.

Yours faithfully,
Robert Abbott
Box 1175
General Post Office
New York,
NY 10116, USA

Dear Sir,

Very little seems to have been published in magazines such as yours on the subject of tape recorders and cassettes used in conjunction with micro-computers. I am sure that some articles and product reviews would be most interesting and helpful.

Having bought an Oric computer recently, I then had to buy a cassette recorder and some cassettes. There seemed to be little to choose from between recorders costing from £17 to £40 so I bought one of the cheapest — and it is working very well indeed. Having read that there were several advantages to be gained by using short tape cassettes intended specifically for use with microcomputers; in particular, that:

1. The tapes had a magnetic characteristic appropriate to this use.
2. A thicker tape was used to give better mechancial stability and longer storage (through reduced print-through).
3. The cassette mechanisms were particularly good to ensure long-term reliable operation.

I tried to buy some. Fortunately, none were available locally, so I bought some good quality audio cassettes (TDK AD60). Using these, the system will CLOAD and CSAVE at 2400 baud with consistent reliability — so I know that all parts of the system work well and also that I am using it properly. During the last week I have managed to get short tape computer cassettes from three separate sources. I bought three cassettes from each source. The price varied from 52p to 62p each. The cassettes from one source bear no name at all, those from another source bear the name of the vendor, and the third group bear the name of what I suspect to be a selling agency which is strangely similar to the name of an established company of good repute who supply record and tape maintenance goods. Of these nine cassettes, only two gave reliable CLOADing and CSAVEing (electro-magnetically), and one of these has failed mechanically. The performances yielded by the others varied from slightly variable to completely useless.

Not one of the computer cassettes ran as quietly (mechanically) or as smoothly in the recorder as the audio cassettes. Only the tape from one source was significantly thicker than the audio tapes. On each of the completely useless tapes (from the most expensive source) there were crease marks up to 1 metre long parallel to, and about 1mm from, one edge, and there was evidence that the tape had been crumpled in several places. There was no obvious evidence of mechanical damage on any of the other tapes.

In order to get a crude comparison of recording sensitivity, I CSAVED the same 6K program (my first attempt at a Fourier analysis/synthesis in BASIC — and it works!) onto each of the tapes under the same conditions. I then listened to each recording played-back through the same recorder. The audio tape yielded the highest volume and the noise was very noticeably more staccato (especially the level-setting tone) than the others. Both the volume and the pitch of the noise from the useless tapes varied massively and cyclically.

The mechanical design of the audio cassette shells and internal components is very much better than that of any of the other cassettes. Some of the design features on the other cassettes' components are, I suspect, as much a disadvantage to the people who assemble them as they are to the eventual user.

Evidently, buying short tape cassettes for use with computers is a risky business. The tapes I bought were a complete waste of time and money. Do any of the established and reputable tape manufacturers, such as BASF, Agfa, TDK, etc, make short tape cassettes for our use, and if so, where can they be bought?

There must be many people who have experienced similar difficulties, and perhaps, blamed their equipment.

Incidentally, there is a slight misprint on page 39 of the May issue. The ROM addresses CALLed in the Oric speed-up procedure are Hex numbers and should be E6CA and E804.

Thank you for a first-rate magazine. I enjoy reading it and I learn quite a lot from each issue.

Yours faithfully,
Charles Wells
Oakham

(*The main trap that many people fall into with regard to computer cassettes is that they buy true digital quality tape. Certified data cassettes are a common example and these are definitely not for use with domestic cassette equipment. However, there are personal computer grade tapes made by a number of the established manufacturers; Scotch (3M), Verbatim and Agfa to name but three, and these are really top quality even though the price is also slightly high. Good quality, and I mean good quality, audio tape such as that made by TDK, BASF, Agfa and Scotch is generally perfectly acceptable provided the baud rate/frequency product is within the manufacturer's specification. But, it should be noted that a number of computers don't generate audio tones but use a true digital format, Sharp are amongst these. Audio tape should not be trusted here unless you have proved to your own satisfaction that it is reliable, TDK AD tape has been used successfully on both our Sharp systems here.

One recent trend worth keeping an eye open for is the marketing of tapes which don't have any magnetic oxide on them at all! Sounds silly, I know, but it has happened and I personally have been caught out by it with the result that an entire night's work was lost. If the tape looks shiny or simply doesn't appear to be recording anything at all when you listen to it on playback don't take a risk — ditch it and return it to the shop for a refund. Ed. *)

16-BIT SURVEY

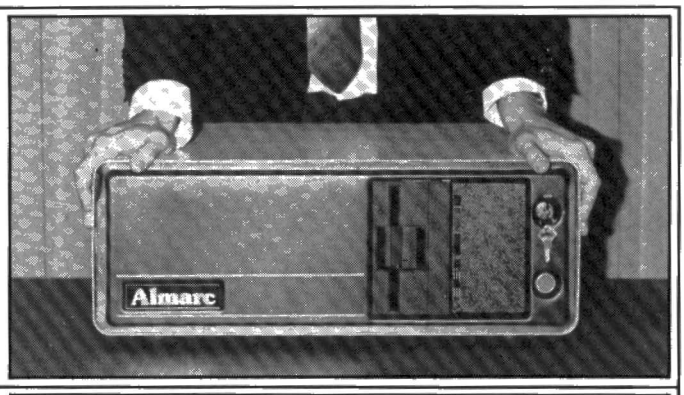
Thinking of buying a 16-bit micro? Take a run down of our brief guide to the cheaper machines before you take the plunge.

We present here a brief guide to some cheaper 16-bit micros currently on the market. The guide is fairly self explanatory. Prices given do not include VAT and of course will vary depending on the options chosen. Virtually any language can be run since all of these micros are disc-based. RAM is given as standard for the machine as is text display.

Although this guide is as accurate as possible at the time of writing, you should of course check all the information with the suppliers, since details are often being changed and new or modified products being made available.

There are a number of other 16-bit machines around and their non-inclusion in this guide is mainly due to lack of space — it is no reflection on the machines themselves.

Almarc Series 16



CPU	8086
SECOND PROCESSOR OPTION	8087/9
RAM	128K
DISCS	800K floppy 5¼" (5,10,15,20M hard)
OS	CP/M-86, MS-DOS (standard), MP/M-86 (extra)
KEYBOARD	100 key detached, numeric keys, 30 function keys
DISPLAY	**TEXT** 80 by 24 **GRAPHICS**
I/O	**SERIAL** 2 **PARALLEL** 2
SUPPLIER	Almarc Data Systems Ltd, 906 Woodborough Road, Nottingham NG3 5QS
PRICE	£2,995-15,000

Burroughs B20 Series

CPU	8086
SECOND PROCESSOR OPTION	
RAM	256K
DISCS	500K floppy, hard disc options
OS	BTOS (standard)
KEYBOARD	98 key detached, numeric keys, 10 function keys
DISPLAY	**TEXT** 80 by 25 **GRAPHICS**
I/O	**SERIAL** 2 **PARALLEL** 1
SUPPLIER	Burroughs Machines Ltd, Heathrow House, Bath Road, Hounslow, Middlesex TW5 9QL
PRICE	from £4,000

Comart Communicator 1000

CPU	8086
SECOND PROCESSOR OPTION	
RAM	128K
DISCS	two 390K floppy
OS	CP/M-86, MS-DOS (standard), MP/M-86 (extra)
KEYBOARD	105 key detached, numeric keys, 8 function keys
DISPLAY	**TEXT** 80 by 24 **GRAPHICS**
I/O	**SERIAL** 1 **PARALLEL** 1
SUPPLIER	Comart, PO Box 2, St. Neots, Huntingdon, Cambs.
PRICE	£2,295-4,545

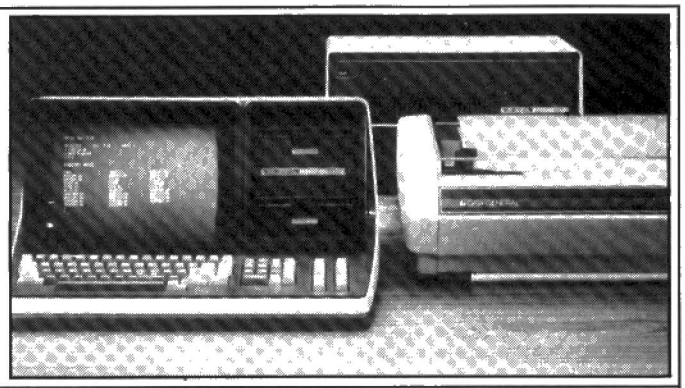
Corvus Concept

CPU	68000
SECOND PROCESSOR OPTION	6801
RAM	256K
DISCS	140K or 1M 8" floppy
OS	Merlin(S), BOS, CP/M (standard)
KEYBOARD	91 key detached, numeric keys, 10 function keys
DISPLAY	**TEXT** 120 by 56 **GRAPHICS** 720 by 560
I/O	**SERIAL** 2 **PARALLEL**
SUPPLIER	Keen Computers, Minerva House, Spaniel Row, Nottingham
PRICE	£4,250

DEC Professional 300 Series

CPU	F11
SECOND PROCESSOR OPTION	Z-80
RAM	260K
DISCS	two 400K floppy
OS	P/OS USCD-p, CP/M80
KEYBOARD	103 key detached, numeric keys, 20 function keys
DISPLAY	**TEXT** 80 by 24 **GRAPHICS** 960 by 240
I/O	**SERIAL** 1 **PARALLEL**
SUPPLIER	DEC Ltd, Digital Park, PO Box 110, Reading RG2 0TR
PRICE	£3,348

Data General Enterprise



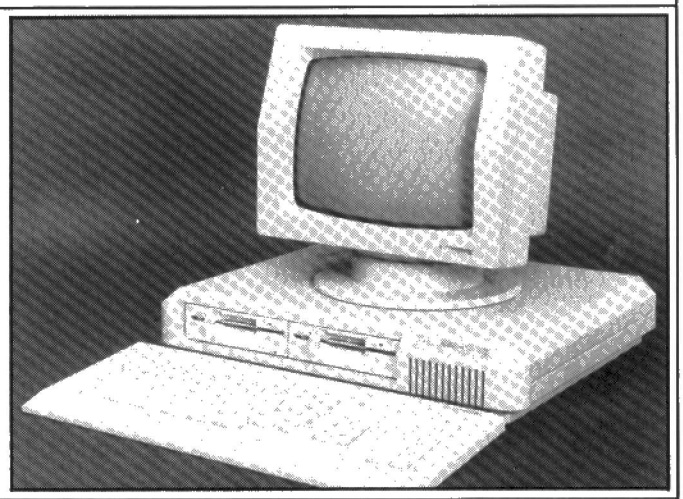
CPU	MN-602
SECOND PROCESSOR OPTION	
RAM	64K
DISCS	two 358K floppy (hard disc option)
OS	Enterprise OMPOS BOS/5 (standard)
KEYBOARD	83 key, numeric keys, 10 function keys
DISPLAY	**TEXT** 80 by 25 **GRAPHICS**
I/O	**SERIAL** 2 **PARALLEL**
SUPPLIER	Data General, 3rd and 4th Floors, Hounslow House, 724-734 London Road, Hounslow, Middlesex TW3 1PD
PRICE	£2,300

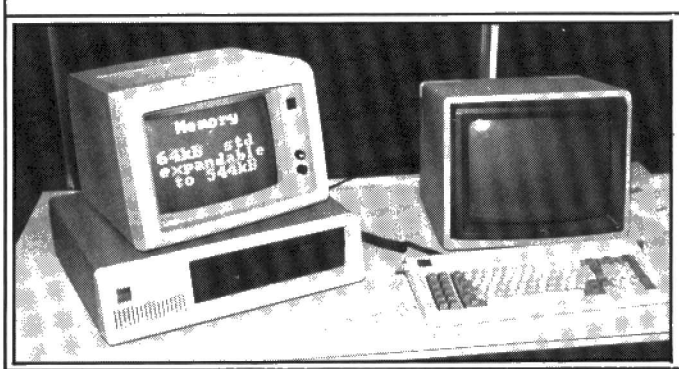
DEC Rainbow 100

CPU	8088
SECOND PROCESSOR OPTION	Z-80A
RAM	64K
DISCS	two 400K floppy
OS	CP/M-86 (standard), MS-DOS (extra)
KEYBOARD	103 key detached, numeric keys, 100 function keys
DISPLAY	**TEXT** 80 by 24 **GRAPHICS**
I/O	**SERIAL** 1 **PARALLEL**
SUPPLIER	DEC Ltd, Digital Park, PO Box 110, Reading RG2 0TR
PRICE	£2,360

FX-20

CPU	8088
SECOND PROCESSOR OPTION	
RAM	12K
DISCS	two 800K floppy
OS	CP/M-86, MS-DOS (standard)
KEYBOARD	108 key detached, numeric keys, 30 function
DISPLAY	**TEXT** 80 by 25 **GRAPHICS**
I/O	**SERIAL** 1 **PARALLEL** 1
SUPPLIER	Future Technology Systems, Lochview Road, Willowyard Industrial Estate, Beith, Ayrshire KA15 1JD
PRICE	from £1500



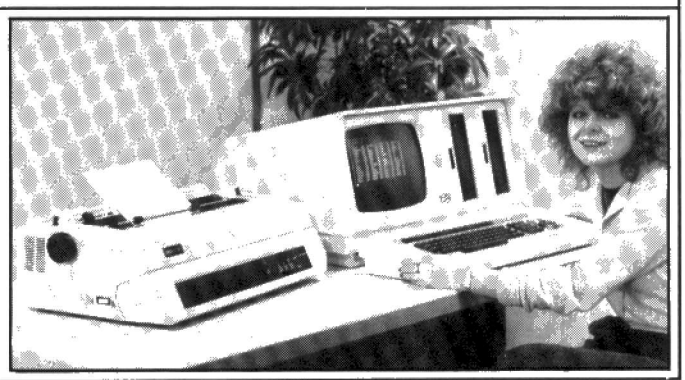


IBM PC

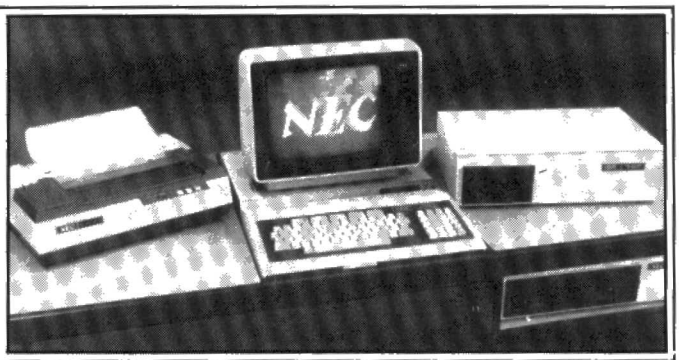
CPU	8088
SECOND PROCESSOR OPTION	
RAM	64K
DISCS	two 320K floppy
OS	MS-DOS (standard), CP/M-86, MP/M-86 (extra)
KEYBOARD	83 key detached, numeric keys, 10 function keys
DISPLAY	**TEXT** 80 by 25 **GRAPHICS** 640 by 200
I/O	**SERIAL** **PARALLEL** 1
SUPPLIER	IBM (UK) Ltd, PO Box 41, North Harbour (Baltic House) Portsmouth PO6 3AN
PRICE	approx. £2,800

LSI M-Four

CPU	8086
SECOND PROCESSOR OPTION	Z-80B
RAM	128K
DISCS	two 400K floppy
OS	CP/M-86 (standard), MS-DOS, MP/M-86 (extra)
KEYBOARD	109 key detached, numeric keys, 37 function keys
DISPLAY	**TEXT** 80 by 24 **GRAPHICS**
I/O	**SERIAL** 2 **PARALLEL** 1
SUPPLIER	LSI Computers, Copse Road, St. Johns, Woking, Surrey.
PRICE	from £2,350



NEC Advanced Personal Computer



CPU 8086
SECOND PROCESSOR OPTION 8231
RAM 128K
DISCS two 1M floppy 8''
OS CP/M-86, MS-DOS (standard)
KEYBOARD 108 key detached, numeric keys, 22 function keys
DISPLAY **TEXT** 80 by 25
GRAPHICS 640 by 475
I/O **SERIAL** 1
PARALLEL 1
SUPPLIER NEC, NEC House, 164-116 Drummond Street, London NW1 3HP
PRICE $3298-4898

Olivetti LI-M20

CPU Z8001
SECOND PROCESSOR OPTION 8086
RAM 164K
DISCS two 300K floppy
OS CP/M-86, MS-DOS (extra)
KEYBOARD 96 key detached, numeric keys, 12 function keys
DISPLAY **TEXT** 80 by 25
GRAPHICS 512 by 256
I/O **SERIAL** 1
PARALLEL 1
SUPPLIER Olivetti, Olivetti House, 86-88 Upper Richmond Road, London SW15 2UR
PRICE $2,395

Orion Business Management System

CPU 8086
SECOND PROCESSOR OPTION
RAM 128K
DISCS two 500K floppy
OS CP/M-86, MP/M-86 (standard)
KEYBOARD 96 key detached, numeric keys, 13 function keys
DISPLAY **TEXT** 40 by 25
GRAPHICS
I/O **SERIAL** 4
PARALLEL 1
SUPPLIER Office and Electronic Machines plc, 140-154 Borough High Street, London SE1 1LH
PRICE £2,950

Powertran Cortex

CPU TMS9995
SECOND PROCESSOR OPTION
RAM 64K
DISCS two floppy
OS Own
KEYBOARD QWERTY Keyboard, numeric key pad
DISPLAY **TEXT** 40 by 24
GRAPHICS 256 by 192
I/O **SERIAL** 1
PARALLEL 1
SUPPLIER Powertran Cybernetics, Portway Industrial Estate, Andover, Hampshire SP10 3NM
PRICE £395

Sanyo MBC 4050

CPU 8086
SECOND PROCESSOR OPTION 8087
RAM 128K
DISCS two 640K floppy
OS CP/M-86 (standard), MS-DOS (extra)
KEYBOARD 100 key detached, numeric keys, 15 function keys
DISPLAY **TEXT** 80 by 25
GRAPHICS
I/O **SERIAL** 1
PARALLEL 1
SUPPLIER Sanyo, 8 Greycayne Rd, Watford WV2 4VQ
PRICE £2,450

Sirius 1

CPU 8088
SECOND PROCESSOR OPTION 8087
RAM 128K
DISCS two 600K floppy or hard disc
OS CP/M-86, MS-DOS (standard), MP/M-86 (extra)
KEYBOARD 95 key detached, numeric keys, 7 function keys
DISPLAY **TEXT** 80 by 25
GRAPHICS 800 by 400
I/O **SERIAL** 2
PARALLEL 1
SUPPLIER ACT, ACT House, 111 Hagley Road, Edgbaston, Birmingham B16 8PF
PRICE £2,395

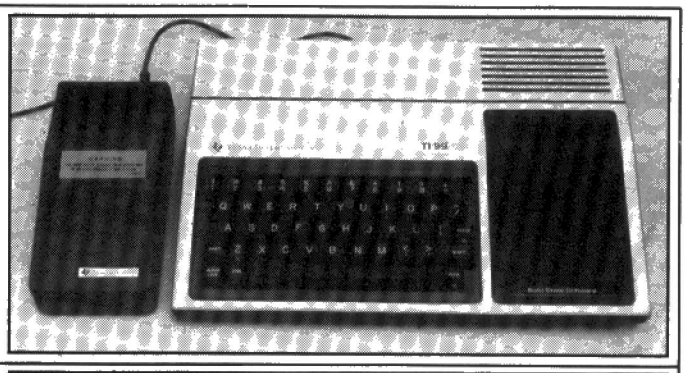
Sord M343

CPU 8086
SECOND PROCESSOR OPTION 8087
RAM 256K
DISCS two 1.2K floppy
OS CP/M-86, MS-DOS (not standard)
KEYBOARD 122 key detached, numeric keys, 20 function keys
DISPLAY **TEXT** 80 by 25
GRAPHICS 640 by 400
I/O **SERIAL** 4
PARALLEL 1
SUPPLIER Sord, Samuel House, St. Albans Street, Haymarket, London SW1Y 4SQ
PRICE £4,350 to £9,500

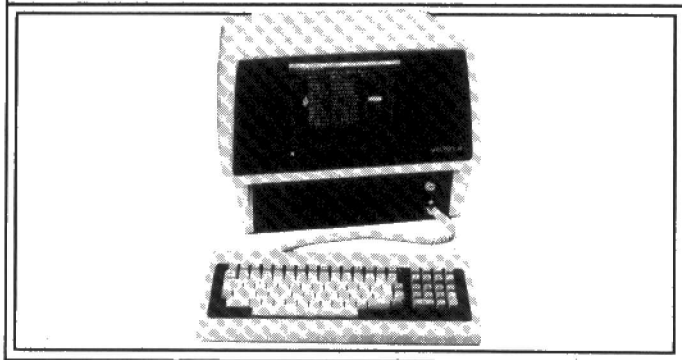
Tandy Model 16

CPU 68000
SECOND PROCESSOR OPTION Z-80A
RAM 128K
DISCS two 1.25M floppy or hard disc
OS TRSDOS, Xenix (standard)
KEYBOARD 76 key detached, numeric keys, 2 function keys
DISPLAY **TEXT** 80 by 25
GRAPHICS 640 by 240
I/O **SERIAL** 2
PARALLEL 1
SUPPLIER Tandy Corp. (Branch UK), Tameway Tower, Bridge Street, Walsall, West Midlands
PRICE £3,650

TI-99/4A



CPU 9900
SECOND PROCESSOR OPTION
RAM 16K
DISCS one 89K floppy
OS NMOS
KEYBOARD QWERTY keys
DISPLAY **TEXT** 24 by 32
GRAPHICS 256 by 192
I/O **SERIAL** 1
PARALLEL 1
SUPPLIER Texas Instruments Ltd, Manton Lane, Bedford MK41 7PU
PRICE £199

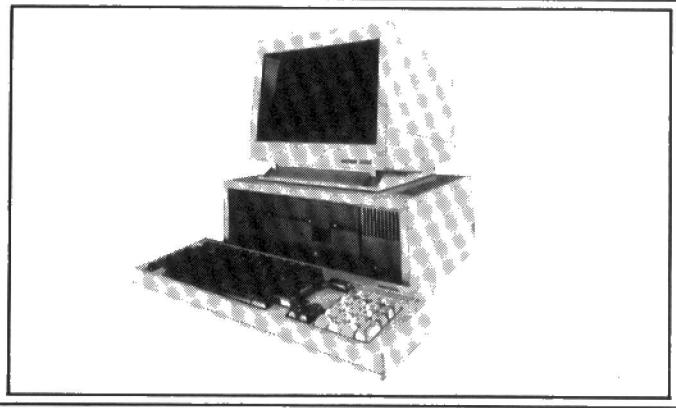


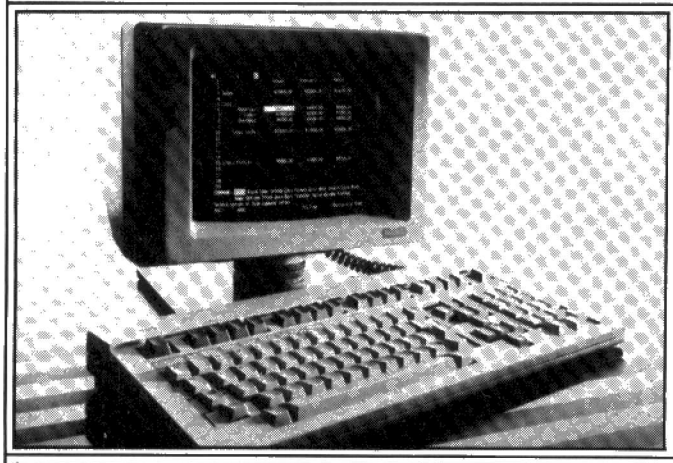
Vector 4

CPU 8088
SECOND PROCESSOR OPTION Z-80B
RAM 128K
DISCS two 630K floppy or 5M hard disc
OS CP/M-86, MS-DOS
KEYBOARD 91 key detached, numeric keys, 15 function keys
DISPLAY **TEXT** 80 by 24
GRAPHICS 640 by 312
I/O **SERIAL** 2
PARALLEL 1
SUPPLIER Vector Graphic Inc., 500 North Ventu Park Road, Thousand Oaks, CA 91320, USA
PRICE £3,350

Victor 9000

CPU 8088
SECOND PROCESSOR OPTION 8087
RAM 128K
DISCS two 600K floppy
OS CP/M-86, MS-DOS (standard)
KEYBOARD 98 key detached, numeric keys, 10 function keys
DISPLAY **TEXT** 80 by 25
GRAPHICS 800 by 400
I/O **SERIAL** 2
PARALLEL 1
SUPPLIER DRG Business Machines, 13/14 Lynx Crescent, Winterstoke Road, Weston-Super-Mare, Avon BS24 9DN
PRICE £2395



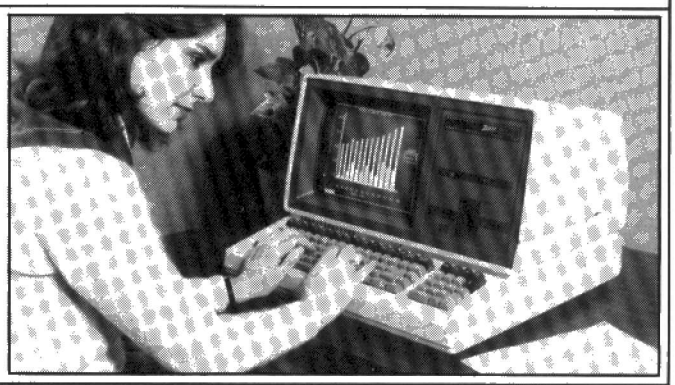


Wang Professional Computer

CPU 8086
SECOND PROCESSOR OPTION Z-80
RAM 128K
DISCS two 360K floppy or 5M hard disc
OS MS-DOS (standard)
KEYBOARD 101 key detached, numeric keys, 32 function keys
DISPLAY **TEXT** 80 by 25
GRAPHICS 800 by 300
I/O **SERIAL** 1
PARALLEL 1
SUPPLIER Wang (UK) Ltd, Wang House, 661 London Road, Isleworth, Middlesex TW7 4EH
PRICE £2,995

Zenith ZF120-22

CPU 8088
SECOND PROCESSOR OPTION 8085
RAM 128K
DISCS two 320K floppy
OS CP/M-86, MS-DOS (standard)
KEYBOARD 108 key detached, numeric keys, 13 function keys
DISPLAY **TEXT** 80 by 24
GRAPHICS
I/O **SERIAL** 2
PARALLEL 1
SUPPLIER Zenith Computers, Bristol Road, Gloucester GL2 6EE
PRICE £2,590



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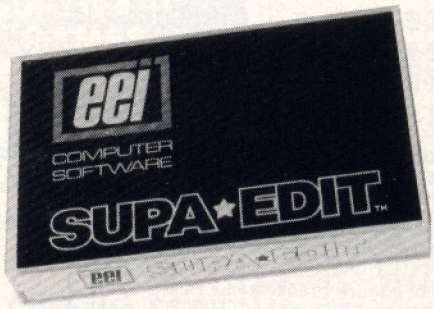

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CT STANDARDS

Our regular page explaining the meaning of the various symbols we use to make programs portable.

It has been very encouraging to see the number of programs submitted using our standard codes for graphics and other non-printable characters. However, it has also become increasingly clear that some of our readers haven't heard of them and this page is intended to set them out once again.

All standards tend to be irksome to adhere to but the ones laid out here are fairly simple and tend to make software easier to maintain by the programmer and simpler to understand for others.

CONTROL THAT CURSOR

Our original standards have now grown with the times. Machines such as the Commodore VIC which have a dual Shift capability can now be incorporated, as can those systems which use Control key functions.

The recently introduced BBC system offers pre-programmed function keys which, we are glad to say, can also be handled by our original coding system. It's nice to see just how well adapted the original standards have become over the last two years! (Indeed, a whole series of books is using them as its *de-facto* standard.) The standards for the cursor controls are given in Fig. 1.

[CLS]	CLear Screen
[HOM]	HOMe cursor
[CL]	Cursor Left
[CR]	Cursor Right
[CU]	Cursor Up
[CD]	Cursor Down
[REV]	REVerse video on
[OFF]	Turn it OFF
[SPC]	SPaCe
[CTL]	ConTroL key
[fn]	Function key (BBC)
[G<]	Graphic left (VIC/MZ-80A)
[G>]	Graphic right (VIC/MZ-80A)

Fig. 1. Our extended set of cursor control standards includes four new functions.

To indicate more than one of the above, an optional number can be placed within the brackets; [4 CL], etc.

The use of square brackets has raised one or two queries. The reason for this choice is that *most* of the common microcomputer BASICs don't use them for specific functions. In fact, at least one machine provides an added bonus by returning a Syntax Error if they are found, a useful check in case you type them in by mistake.

The code [SPC] was added to the list of cursor control codes to get over the problem of indicating just how many spaces are contained in the gap in the printout. The other common variant of the code for spaces is used by the ZX people. Their choice was '.' and this crops up in the various newsletters they publish.

The code [RVS] has caused a few headaches. This is really specific to the PET where the character set can be displayed in reversed video. On machines which don't have this facility you should either find a character in the set which is the reversed image of the one you want and use that or simply ignore it and use anything else you fancy! Don't forget, you may have to look up and alter the values used elsewhere in the program.

THE GRAPHIC SOLUTION

It soon became obvious that the techniques applied to the confusing cursor controls could also be applied to the graphics symbols. The following standard is now in general use in programs published in *Computing Today*.

If a graphics character or characters are to be displayed in a listing (as opposed to POKE codes or CHR$( ) codes) then they are indicated by the method shown in Fig. 2.

Several people have asked what the relationship between the POKE value for a character and that of its shifted graphic might be. In general the shifted version of any character will be 64 greater than the value of that character. This applies to both PET and MZ-80K systems in all cases.

This can be taken further to include machines which use a pixel graphics set rather than pre-programmed PET-style characters and the series of codes for these is given in Fig. 3. As is nearly always the case there is one machine to which the standard shown in Fig. 3 does not apply — Tangerine's Microtan/Micron. This machine uses a four by two cell structure for its pixel graphics instead of the Prestel/Teletext three by two cell. The method for calculating the value to assign to 'P' is shown in Fig. 4, and is fortunately nice and simple.

MAKING REMARKS

Many people scorn the use of REMs within programs but, during the development at least, they are extremely useful. One of the documentation methods that we use is to keep our back-up copy of our programs on a 300 Baud CUTS tape with all the REMs in place: the working copy, be it on tape or disc, is REMless in order to save space.

It is also good programming 'manners' to give your REMs odd line numbers:

```
3999 REM ** CRASH PROOF INPUT
4000 INPUT "THE NUMBER OF ENTRIES ";A
```

A remarkable number of submitted programs have jumps that go not to the relevant point in the program, but to the REM statement. This can cause severe problems when re-numbering after removing the REMs.

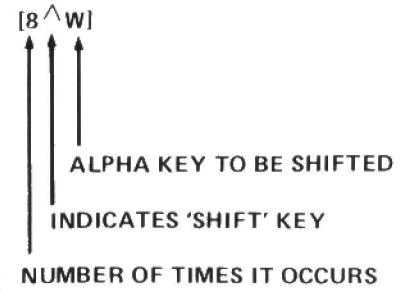

Fig. 2. The way we indicate block graphics on machines like the PET and Sharp. The VIC system of Shift Left and Shift Right is shown in Fig. 1.

1	2
4	8
16	32
64	128

Fig. 4. To convert a Tangerine pixel code into its blocks, simply decode the number into its binary or Hex value and fill in the relevant squares.

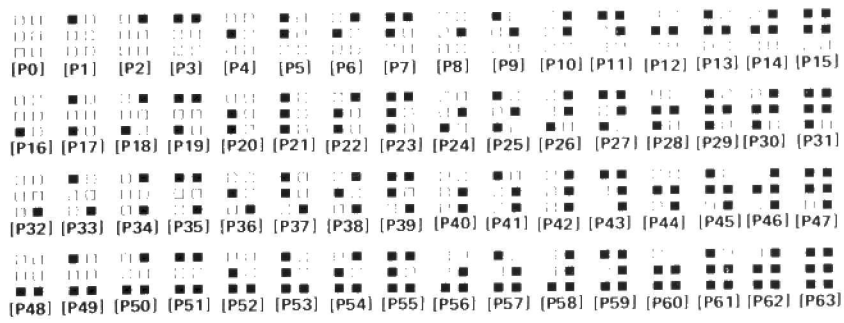

Fig. 3. The standard pixel codes; they will work on most computers which employ this technique as well as for Teletext and Prestel.

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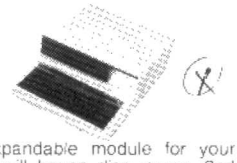

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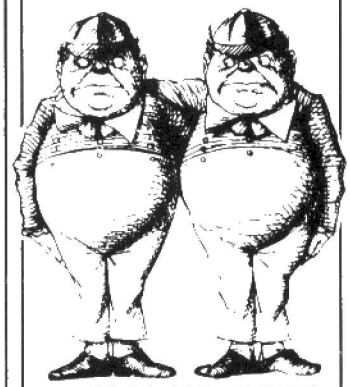

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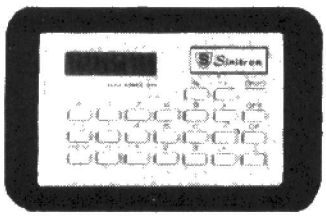

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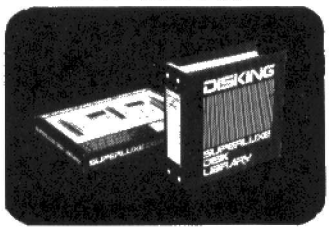

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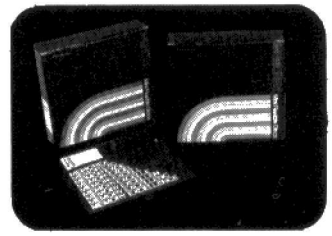

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